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ATLAS AND TEXT-BOOK

OF

HUMAN ANATOMY

BY

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VOLUME II

THE VISCERA, INCLUDING THE HEART

With 214 Illustrations, Mostly in Colors

PHILADELPHIA AND LONDON

W. B. SAUNDERS COMPANY

1911

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Reprinted January, 1909

Reprinted November, 1911

PRINTED IN AMERICA

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W. B. SAUNDERS COMPANY
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PREFACE

The second volume of the Atlas and Text-Book of Human Anatomy is the immediate continuation of the first, and treats of the viscera and of the heart. It has seemed desirable to include the heart with the viscera since it is usually dissected in common with them and its arrangement with them in the Atlas will consequently be more convenient for the use of the student.

The selection and mode of reproduction of the dissections are identical with those employed in the first volume. Topographic anatomy as such has not been specially considered, but in many instances, particularly in the regional illustrations, the method of presentation is necessarily of a topographic character.

All the illustrations in this volume, except Figs. 365–367,* have been produced by the artist, K. Hajek, in a thoroughly praiseworthy manner. The same methods of reproduction have been employed as in the first volume, viz. autotype (partly multicolored), multicolored lithography (Figs. 328, 365–367, 416, 417, 455, 459, 460, 515, 516, and 520–523), and the three-color process (Figs. 405–410, 413, 461, 462, 518, and 519). Explanatory figures and diagrams have been reproduced by simple line-etchings. Photography has also been made the basis for all the original drawings and has been uniformly utilized for the general lines of the illustrations.

In the production of this volume even more than in that of the first, the publishers have spared neither effort nor expense to insure the greatest excellence of the illustrations.

THE AUTHOR.

*The originals of these three illustrations were drawn by the artist, A. Schmitson.

GIFT

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ATLAS AND TEXT-BOOK

OF

HUMAN ANATOMY.

SPLANCHNOLOGY.

GENERAL SPLANCHNOLOGY.

The word viscera in its broadest sense includes all of the organs situated within the cavities of the body, so that the brain and spinal cord, the heart, and even some of the organs of special sense, such as the eye, might properly be described under this designation. It has, however, been customary for the systematic anatomist to include under the term only the organs contained within the visceral tube* and to consider the brain and spinal cord under neurology, the heart† under angiology, and the eye under the organs of special sense.

The organs contained within the visceral tube of the body may be grouped into three chief subdivisions: (1) the digestive apparatus; (2) the respiratory apparatus; and (3) the urogenital apparatus. The uropoietic and genital organs are usually classified together on account of their intimate topographic relations, their associated development, and their common origin (with the exception of some individual portions) from the mesoderm, and there is equal or even greater reason for regarding the digestive and respiratory organs as parts of a common apparatus, since the respiratory viscera make their appearance simply as an appendage of the digestive tract, the parts of both systems, with the exception of the anterior portion of the mouth, are derived from the entoderm, and certain portions of the digestive tract subserve also the function of respiration. In each of the three chief subdivisions, two principal constituents may be recognized, namely, a tubular canal and a series of non-tubular so-called parenchymatous organs, whose chief component is termed *parenchyma*. This is usually a soft, grayish-red or brownish mass, which constitutes the secreting epithelial substance of the glandular structures belonging to the individual apparatus, or more rarely consists of lymphatic tissue, as in the spleen.

* For a definition of this the reader is referred to the general introduction which follows the third volume.

† From a topographic standpoint the heart might also be included with the viscera, especially on account of its relation to a serous cavity.

Since the constituents of each individual apparatus are arranged about a central tubular canal we also speak of the digestive tract, the respiratory tract, and the urogenital tract. The first two may also be combined under the name of the intestinal tract and, conversely, a portion of the urogenital tract may be referred to as the genital tract. The main tubular portion of each apparatus may be spoken of in general as a mucous tract, since it is lined by a mucous membrane, the most important part of which is the epithelium which covers its surface and which alone constituted the primitive visceral tube, although it also contains the *tunica muscularis mucosæ*, a thin layer of involuntary muscle-tissue which is well developed only throughout the greater portion of the digestive tract.

In addition to the mucous membrane the tubular portions of the visceral tract also possess throughout considerable portions of their extent a *tunica muscularis*, the fibers of which are frequently arranged in several layers, in which the fibers pass usually in transverse and longitudinal directions. The mucous membrane is generally freely movable upon the muscular tunic on account of the interpolation of a layer of loose connective tissue, the *tunica submucosa*, and both this and the mucous layers may contain small glands.

(For a more minute description of the structure of the mucous membrane, etc., the reader is referred to the Sobotta-Huber "Atlas and Epitome of Normal Histology," Saunders' Medical Hand-Atlases.)

The larger glandular structures of the viscera are usually arranged as lateral appendages of the tubular portions and form the greater portion of the so-called parenchymatous organs. Their

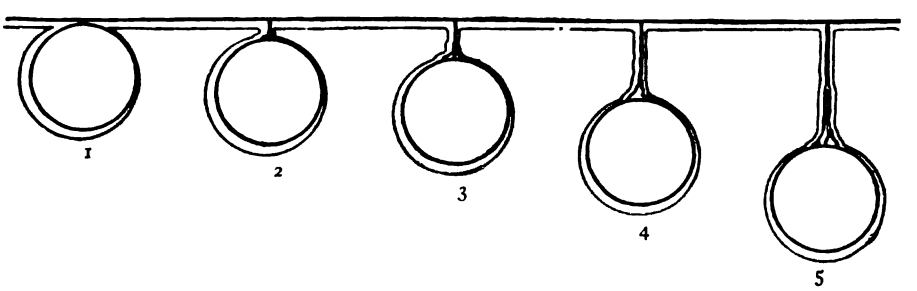

FIG. 321.—Diagram showing the relation of the viscera to the peritoneum (red): 1, A viscus which rests on the posterior abdominal wall; 2 to 5, viscera which are more or less distant from the posterior abdominal wall.

excretory ducts empty into the main tube and, like the glands themselves, are developed as diverticula from this, the secreting glandular epithelium being in direct continuity with the epithelium of the mucous membrane of the tube. In contradistinction to these glands (*glandulæ evehentes*), whose secretion is poured into the tube of mucous membrane through excretory ducts, are those which possess no excretory ducts (*glandulæ clausæ*), although some of the latter group may have possessed ducts up to a certain period in their development, as is the case with the thyroid gland.

In addition to the true epithelial glands there are also false or vascular glands, represented chiefly by the lymphatic glands (*lymphoglandulæ*), the tonsils, and the spleen. The thymus is sometimes regarded as belonging to this group, but it is developed as a true epithelial gland and only later loses its epithelial characteristics by degeneration. Other glands which belong

to the group are the superficial lymphatic structures which occur adherent to the mucous membrane of the digestive apparatus, among which are the tonsils.

(For a more minute description of the true and false glands the reader is referred to the Sobotta-Huber "Atlas and Epitome of Normal Histology," Saunders' Medical Hand-Atlases.)

The viscera may either be surrounded by the skeleton and muscles, as is the case with those of the neck, or else may lie in the large body-cavities. These contain the so-called serous cavities * or sacs, *i. e.*, closed spaces, which are developed from the primitive body cavity or cœlom. Their

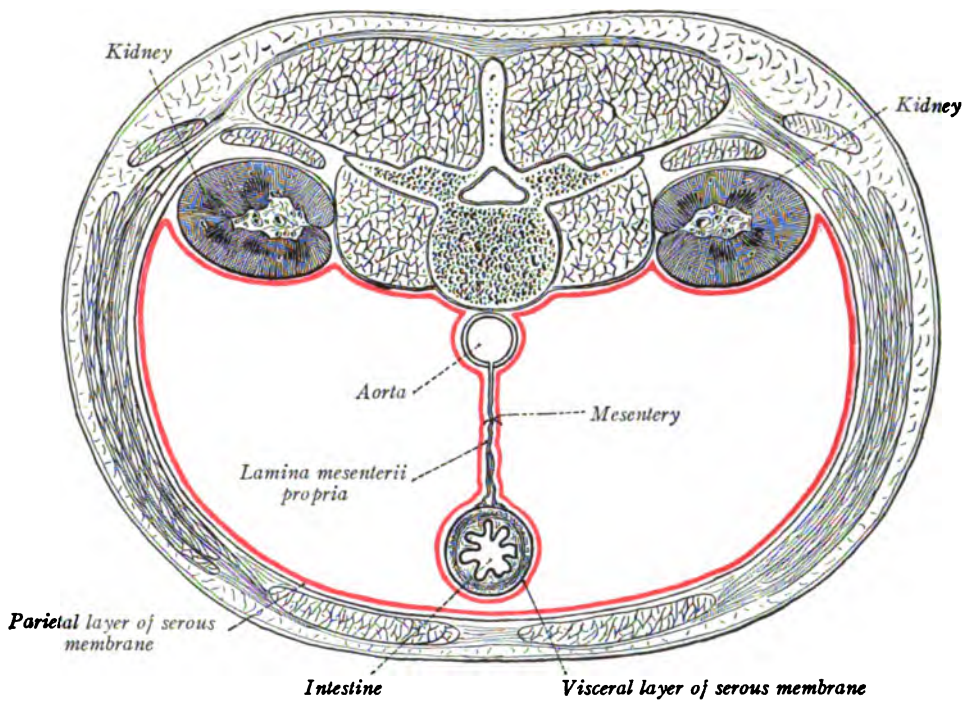

FIG. 322.—Diagram of a serous cavity.

lining membranes are covered with flat serous epithelium and are known as serous membranes (*tunicæ serosæ*).

The serous membranes are: the *peritoneum*, forming the single peritoneal cavity; the *pleuræ*, forming the paired pleural cavities; the *pericardium*, forming the single pericardial cavity; and the paired *tunicæ vaginales propriæ* (*testis*). The latter, the last formed of all the serous cavities, originate from peritoneal diverticula which accompany the testicle in its descent (see page 127), and are consequently found only in the male. The pericardium surrounds none of the actual

* The true serous cavities are lined by a serous membrane and should not be confounded with the false serous cavities, which are simply interspaces in the connective tissue. An example of the latter is furnished by the cavities in the vicinity of the central nervous system.

viscera, but contains the heart; the pleuræ envelop the two lungs; and the peritoneum invests the greater part of the digestive tract as well as a portion of the urogenital apparatus.

The general relation of the serous cavities to the viscera which they harbor is practically uniform throughout (Fig. 321). The viscera push themselves more or less deeply into the closed serous sac * so that they carry ahead of them an investment of serous membrane. There may consequently be distinguished a *parietal layer* of peritoneum which lines the abdominal walls and a *visceral layer* which provides a serous envelope for the viscera (Fig. 322). If a viscus lies freely in a serous cavity so that no portion of its surface is in contact with the body wall it is connected with this wall by a plate of connective tissue, the *lamina mesenterii propria*, which transmits its vessels and nerves, and at the junction of this lamina with the abdominal wall the parietal layer of the peritoneum becomes continuous with the visceral layer (Fig. 322). The structure formed in this manner, and consisting of the lamina mesenterii propria covered on either side by serous membrane, is termed a *mesentery*.

According to the distance of the viscus from the abdominal wall the mesentery is long or short, and the particular viscus is correspondingly more or less movable. This is the relation held by the different portions of the intestine to the abdominal wall. Upon the other hand, the viscus may project but slightly into the serous cavity, so that it is applied to the body wall by a broad surface which remains entirely free from serous investment (Fig. 321, 1); this is the case with the adult kidney (Fig. 322). Between these two conditions every possible stage of transition occurs. Sometimes the visceral serous coat is intimately adherent to the surface of the viscus,† forming its *tunica serosa*, and in other cases the two structures are separated by a layer of loose areolar tissue, the *tunica subserosa*, which usually contains fat.

The serous surfaces of the viscera invested by serous membrane are in such close contact with each other and with the parietal layer that only capillary spaces remain, and these are filled by a very small quantity of serous fluid.

In the individual sections upon Special Splanchnology those organs which possess topographic and functional relations to the system under discussion will also be considered, so that the spleen will be described with the organs of digestion and the suprarenal bodies with the urinary apparatus.

One of the first organs to be laid down in the embryo is the intestinal tract, which arises by a folding of the entoderm, eventually transformed into a tube. This soon enters into relation with the primitive body cavity or cœlom, which originates as two cavities, one on either side of the middle line, between the so-called lateral plates of the mesoderm, the two cavities subsequently fusing to form a single one. From the primitive intestinal tract are formed all the organs of the digestive and respiratory tracts, while the urinary and genital organs are laid down separately, although in the human embryo, as in the adults of almost all the vertebrates except the higher mammals, they terminate posteriorly in a cavity, the cloaca, which also receives the termination of the primitive intestine (see page 126). For a certain period therefore, even in the human embryo, all the true viscera are connected in the posterior portion of the body.

* In the female the peritoneal cavity is not completely closed, but is in communication with the cavity of the female sexual apparatus.

† This adherence is most complete in the ovary, where the serous epithelium of the peritoneum becomes directly continuous with the so-called germinal epithelium of the ovary and the connective-tissue layer of the peritoneum simply passes into the ovarian stroma.

SPECIAL SPLANCHNOLOGY.

THE DIGESTIVE APPARATUS.

The digestive apparatus (Fig. 323) includes the actual intestinal tract, taking those words in their widest sense, and according to its development this tract may be divided into four portions: (1) The oral cavity; (2) the foregut; (3) the midgut; (4) the hindgut. The oral cavity extends from the lips to the isthmus of the fauces; the foregut comprises the pharynx, the œsophagus, and the stomach; the midgut is identical with the small intestine; and the hindgut is composed of the large intestine and the rectum. The tract commences at the mouth and terminates at the anus.

Associated with the digestive tube are a large number of glandular appendages, namely, the small and large salivary glands in the mouth; the pharyngeal, œsophageal, and gastric glands in the foregut; and the duodenal and intestinal glands, as well as the two largest glands of the digestive apparatus, the pancreas and the liver, in the midgut. The hindgut has only the intestinal glands situated in its walls. Although the spleen is not really an organ of the digestive tract, since it originates in the mesenchyma and not from the entoderm, it is usually described with the digestive apparatus. The wall of the digestive tube also contains lymphatic aggregations of variable size, whose chief peculiarity is that their parenchyma is adherent to the superficial epithelium of the gut, which thus becomes infiltrated by their cellular elements. In the upper portion of the tract the larger of these aggregations are designated as *tonsils*, in the lower portion as *aggregated lymphatic follicles* (Peyer's patches).*

For a certain period in the human embryo the gut is a completely closed straight tube possessing neither an oral nor an anal opening. These orifices are formed later, when the tract has undergone further differentiation, as oral and anal ectodermic depressions which deepen and gradually approach the anterior and posterior portions of the intestinal tube, until the lumen of the tube is separated from the outer world only by thin membranes, known respectively as the pharyngeal and anal membranes. With the rupture of these membranes the two primary body openings are formed, from which are soon developed by the formation of septa the oral and nasal cavities upon the one hand and the anal and urogenital orifices upon the other. The oral depression forms a considerable portion of the subsequent oral cavity, which is consequently very largely of ectodermic rather than of entodermic origin.

THE ORAL CAVITY.

The oral cavity is the first portion of the entire digestive tract. It is an irregularly shaped, elongated cavity, situated in the lower portion of the face, and its boundaries are partly bony and partly musculocutaneous. It is divided by the two rows of teeth into two incompletely separated spaces, the *vestibulum oris* and the oral cavity proper.

THE VESTIBULUM ORIS.

The *vestibulum oris* (also termed the *buccal cavity*) (Figs. 326, 327, and 328) is a narrow, somewhat semicircular space situated between the cheeks and lips and the teeth. When the

* The true lymphatic glands, which are found in the vicinity of the digestive apparatus, will be considered in the section upon Angiology.

FIG. 324.—The mouth, chin, and nasal region seen from in front.

FIG. 325.—The labial glands seen from behind, the mucous membrane having been removed.

FIG. 326.—View of the oral cavity from in front.

The cheeks have been divided for some distance outward from the angles of the mouth; the jaws are widely separated; and the lips are everted.

---

upper and lower teeth are in apposition it communicates with the oral cavity proper behind the last molar tooth, and it communicates with the outer world through the oral orifice (*rima oris*).

This is bounded by the *lips* (Fig. 324), which are connected at the angles of the mouth by the *labial commissures* and form the greater portion of the anterior wall of the vestibule. The upper lip is longer than the lower and its external surface presents a rather broad, shallow, median furrow, known as the *philtrum*, which runs downward toward the vermilion border and terminates in the *tubercle* of the upper lip. The upper lip is separated from the cheek by the *nasolabial groove*, which passes outward and downward in a slight curve from the ala of the nose. The outer surface of the lower lip is traversed by the *mentolabial groove*, a transverse furrow which separates it from the chin.

The lips are composed of the skin, the labial muscles (see Vol. I, page 180), and the labial mucous membrane, the last containing the *labial glands* (Fig. 325), which are mucous glands varying in size from that of a lentil to that of a small pea.

The posterior surfaces of the lips are connected with the mucous membrane (*gingiva*) covering the alveolar processes of the maxillæ and mandible by thin folds of mucous membrane known as the frenula of the lips (Fig. 326). The frenulum of the upper lip is always longer and more distinct than that of the lower.

Laterally from the lips the cheeks (*buccæ*) form the external boundaries of the vestibulum oris (Fig. 326). Like the lips, they consist of integument (with large hairs in the male), of muscles (see Vol. I, p. 180), and of mucous membrane which in this situation is thin and contains the *buccal glands* (Fig. 325) partly embedded in the buccinator muscle (see Vol. I, p. 181) or even lying upon its outer surface. In the angle between the buccinator and masseter muscles (see Vol. I, p. 183) is situated a marked accumulation of fatty tissue, the *buccal fat mass*.

The portion of oral mucous membrane which envelops the alveolar processes and passes between the teeth to be attached to the interalveolar septa is of considerable thickness and is known as the gum or *gingiva* (Fig. 329). It is firmly attached to the periosteum by its submucous layer and is distinguished from the remainder of the oral mucous membrane by its firm structure.

The posterior wall of the vestibulum oris is formed by the alveolar processes enveloped by the oral mucous membrane and by the anterior or anterolateral teeth.

The buccal mucous membrane also presents the orifice of the parotid duct (see page 38).

THE ORAL CAVITY PROPER.

The oral cavity proper (Figs. 326, 327, and 328) is bounded above by the *palate*, which separates it from the nasal fossæ. Its floor is formed chiefly by the tongue (see page 34), which, when the mouth is closed, practically fills the cavity, only a relatively small space remaining

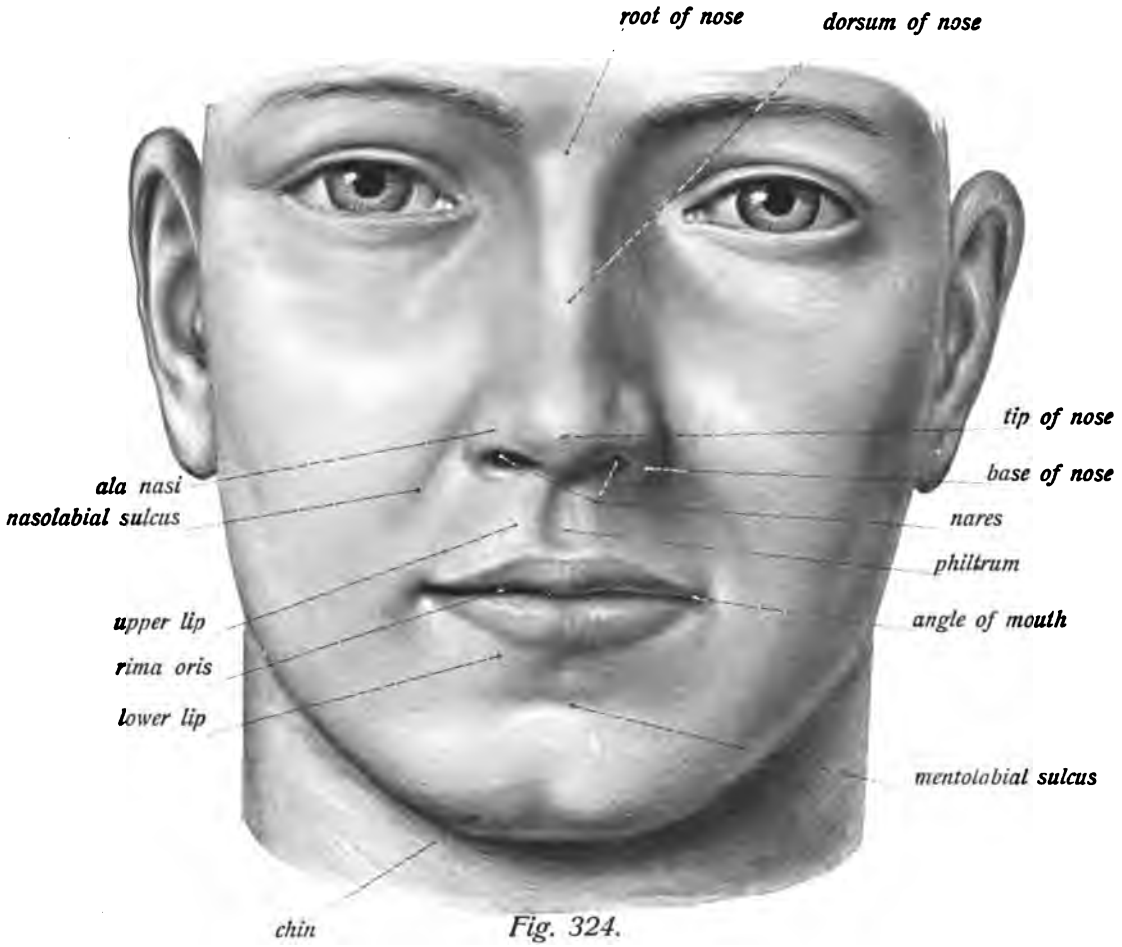

Fig. 324.

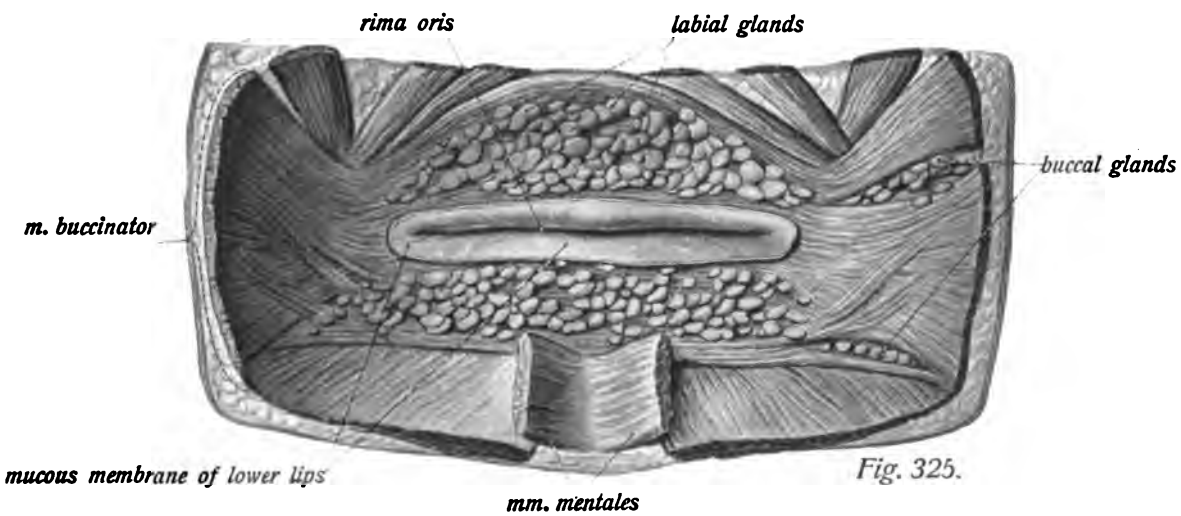

Fig. 325.

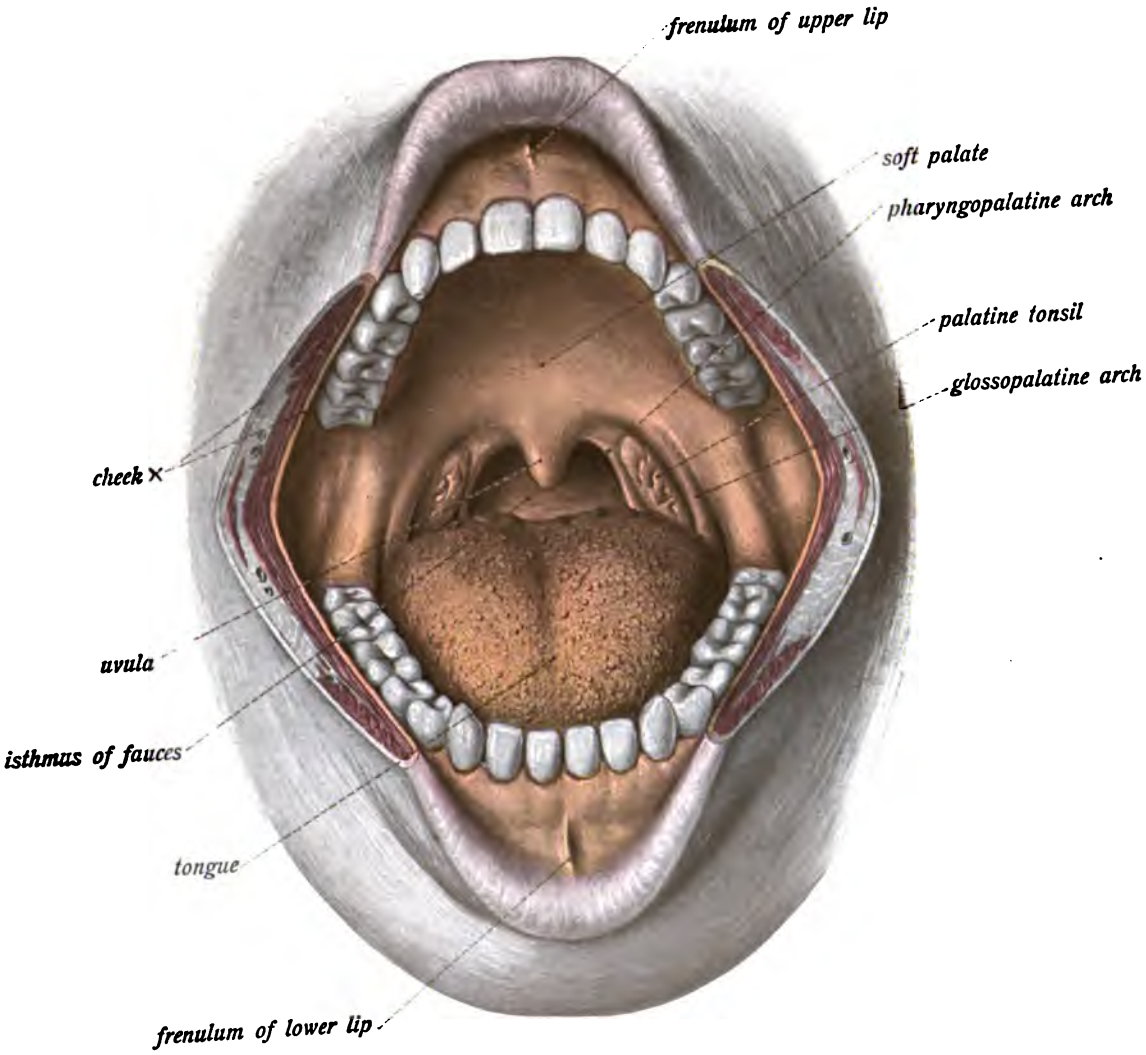
frenulum of upper lip
soft palate
pharyngopalatine arch
palatine tonsil
glossopalatine arch
cheek
uvula
isthmus of fauces
tongue
frenulum of lower lip

Fig. 326.

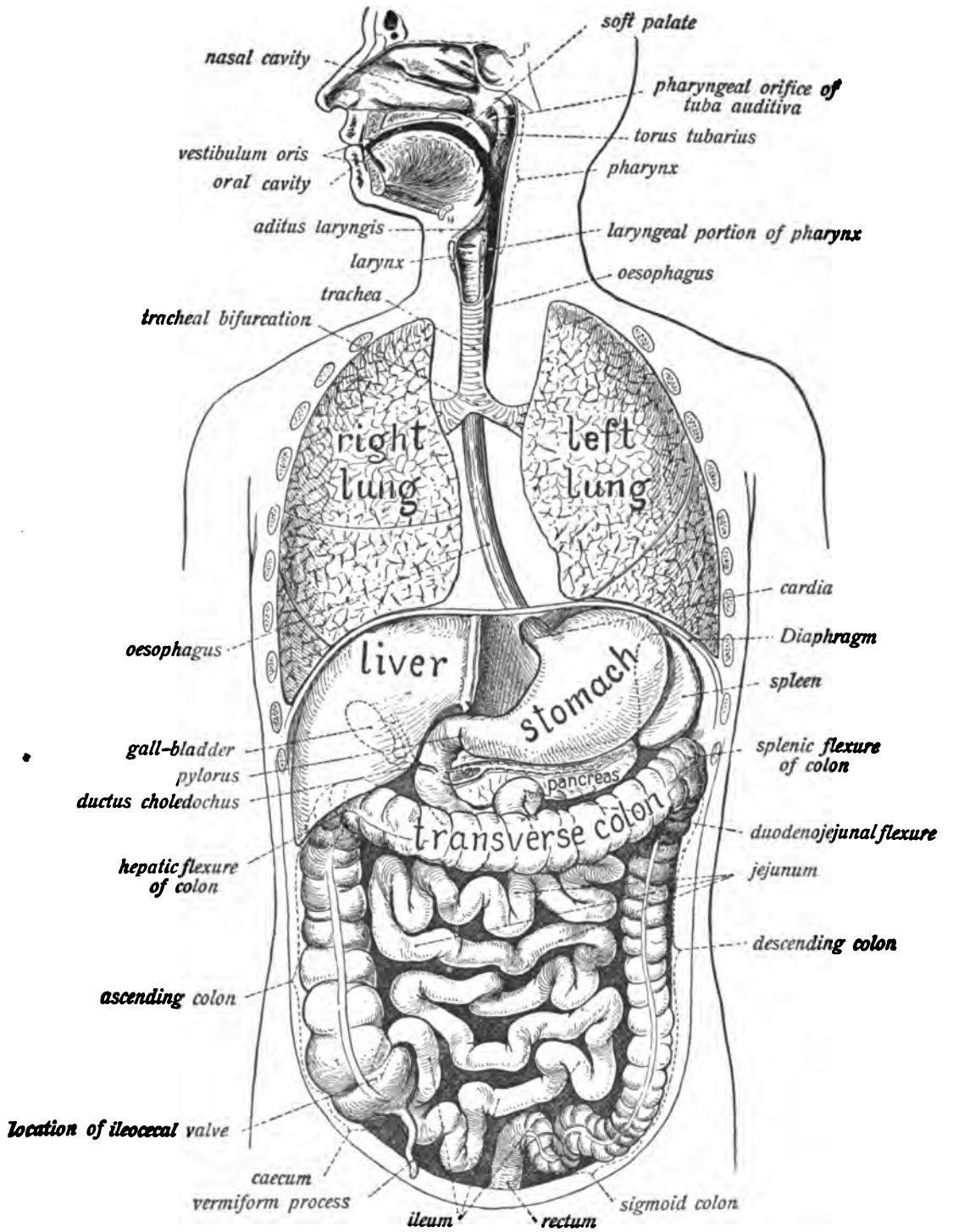

FIG. 323.—Diagram showing the arrangement of the digestive and respiratory organs.

FIG. 327.—View of the oral cavity and palate after dividing the cheeks.

The mucous membrane of the palate has been partly removed on the right side to show the palatine glands and on the left side the glands have been removed to show the interlacing of the muscles of the velum palatinum (*).

FIG. 328.—A median sagittal section of the viscera of the head and neck.

---

between the dorsum of the tongue and the palate. The anterior and lateral boundaries are formed by the dental arches, while posteriorly the cavity is only partly bounded by the velum palatinum and the palatine arches, since it communicates in this direction with the pharynx through the *isthmus of the fauces*.

The *palate*, the roof of the oral cavity (Figs. 327 to 330), is further divided into the *hard* and the *soft palate*. The former accurately corresponds to the relief of the hard palate of the skeleton (see Vol. I, p. 78), and its mucous membrane is thick and firm, like that of the gums, and is intimately connected with the periosteum by strong submucous fasciculi. It contains many mucous *palatine glands* which are of irregular shape and vary in size from 2 to 5 mm.

In the median line the mucous membrane of the hard palate forms a slightly elevated palatine raphe, the anterior extremity of which terminates in a small, rounded, wartlike projection, the *incisive papilla*,* which corresponds to the position of the incisive foramen. Anteriorly it also presents three or four transverse palatine folds or *rugæ* (Figs. 327 and 329), the development of which is subject to considerable variation.

The *soft palate* or *velum palatinum* (Figs. 326 to 328 and 329) is a muscular plate, richly supplied with glands and covered upon both surfaces by mucous membrane (see page 41), which separates the oral cavity from the nasal portion of the pharynx. It hangs obliquely downward and backward, its base being attached to the posterior border of the bony palate and its anterior surface directly continuous with the mucous membrane of the hard palate. At either side it is continuous with the palatine arches which form the lateral boundaries of the fauces and it terminates below and behind in a round conical appendage, the *uvula*, whose tip, when its muscles are at rest, is curved forward. The anterior surface of the soft palate is concave and directed toward the oral cavity, the posterior is convex and looks toward the pharynx. The mucous membrane of the soft palate is fairly smooth, although it is thrown into slight folds by the relaxation of the muscles; it is thinner than that of the hard palate and contains a much greater number of mucous *palatine glands* (Fig. 327), which are also larger and more closely crowded together. The lateral portions of the soft palate constitute the two *palatine arches*, two folds of mucous membrane containing muscles, which form the lateral boundaries of the isthmus of the fauces (Fig. 326). (See also page 41.)

The more anterior fold, the *glossopalatine arch*, passes in a curve from the lower margin of the soft palate to the mucous membrane of the lateral border of the tongue, where it broadens somewhat and terminates as the *plica triangularis* (Fig. 351). The posterior or *pharyngopalatine arch* is thicker and straighter than the anterior one and extends between the soft palate and the outer wall of the oral portion of the pharynx.

* The incisive papilla not infrequently exhibits in its center one small or sometimes a paired pit-like depression, the remains of the incisive duct (see page 89).

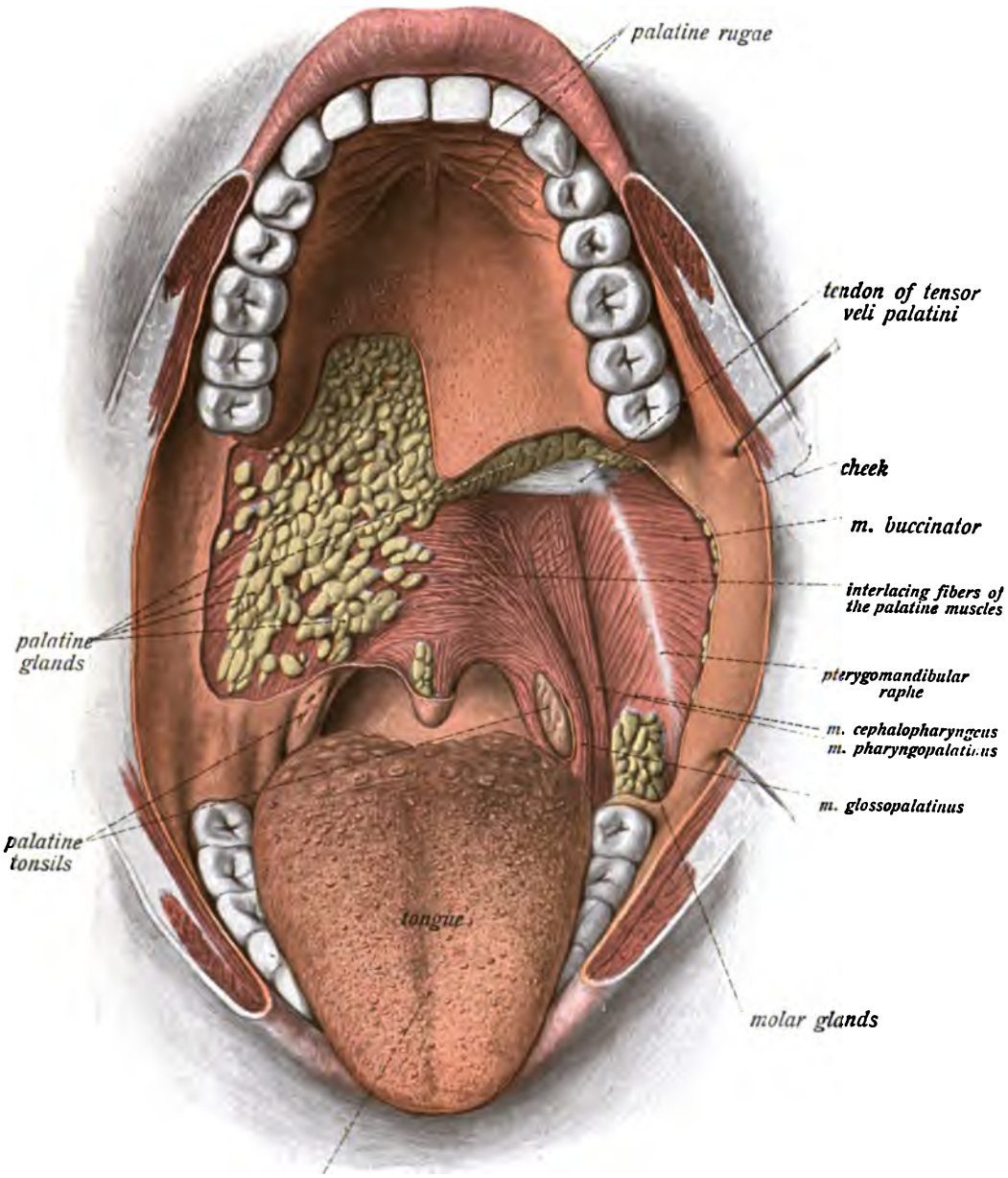
palatine rugae
tendon of tensor veli palatini
cheek
m. buccinator
interlacing fibers of the palatine muscles
palatine glands
pterygomandibular raphe
m. cephalopharyngeus
m. pharyngopalatinus
m. glossopalatinus
palatine tonsils
tongue
molar glands
median sulcus of tongue

Fig. 327.

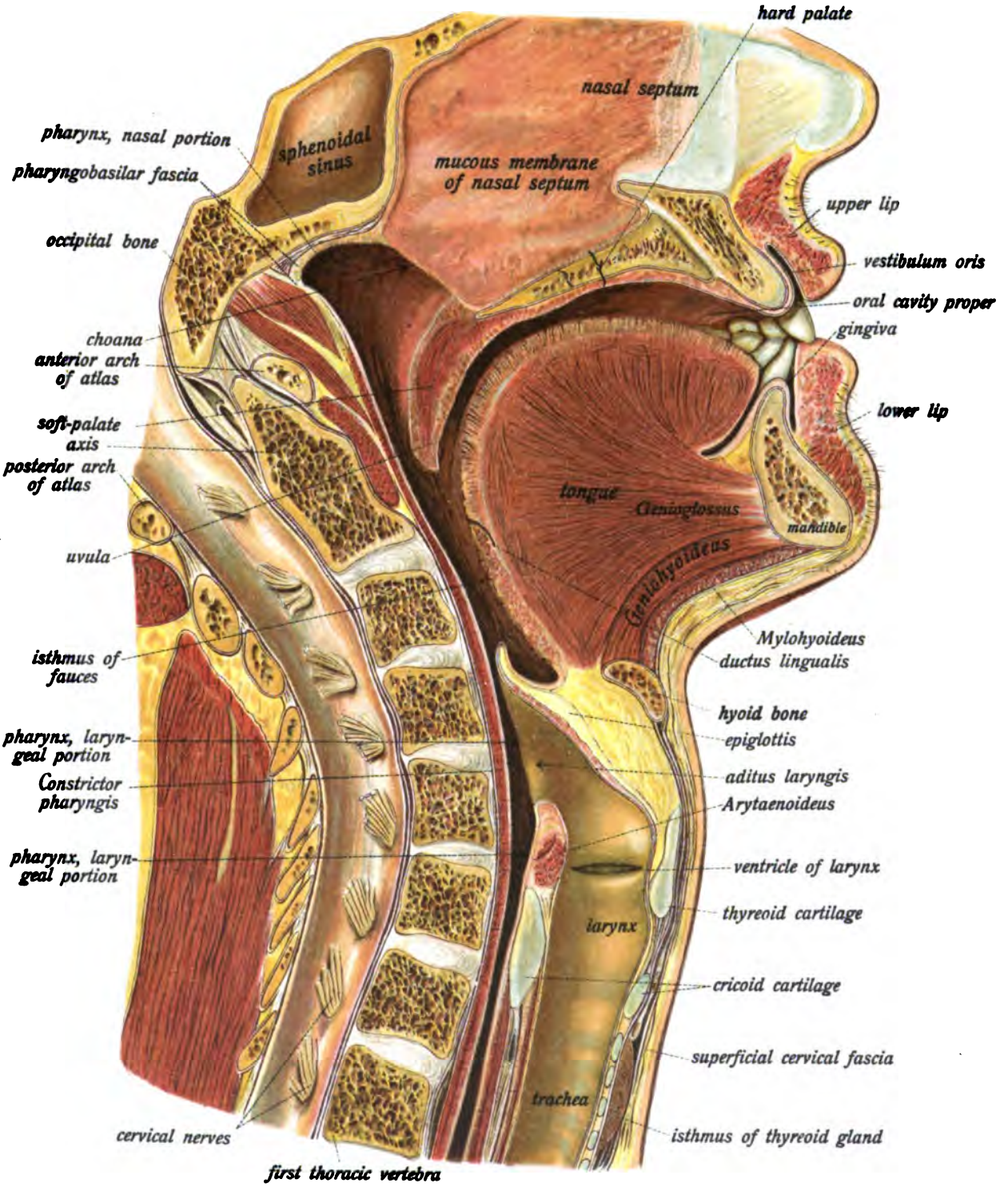
hard palate
nasal septum
pharynx, nasal portion
sphenoidal sinus
pharyngobasilar fascia
mucous membrane of nasal septum
upper lip
occipital bone
vestibulum oris
oral cavity proper
choana
gingiva
anterior arch of atlas
lower lip
soft palate
axis
posterior arch of atlas
tongue
Genioglossus
mandible
uvula
Geniohyoideus
Mylohyoideus
isthmus of fauces
ductus lingualis
hyoid bone
pharynx, laryngeal portion
epiglottis
aditus laryngis
Constrictor pharyngis
Arytaenoideus
pharynx, laryngeal portion
ventricle of larynx
thyreoid cartilage
larynx
cricoid cartilage
superficial cervical fascia
trachea
cervical nerves
isthmus of thyreoid gland
first thoracic vertebra

Fig. 328.

Between the palatine arches upon either side is found the *tonsillar sinus*, in which is situated the *palatine tonsil* (Figs. 326, 327, 363, and 364), a somewhat flat, oblong elevation upon the surface of which deep fissures or depressions, the *fossulæ tonsillares*, are visible. Its borders are not very sharply circumscribed, but it fills more or less completely the space between the two palatine arches.* Just above the tonsil there is frequently a deep triangular pit, the *supratonsillar fossa*, which is believed to be the remains of the second pharyngeal pouch of the embryo. It contains the orifices of mucous glands which are everywhere so plentiful in the tonsillar region.

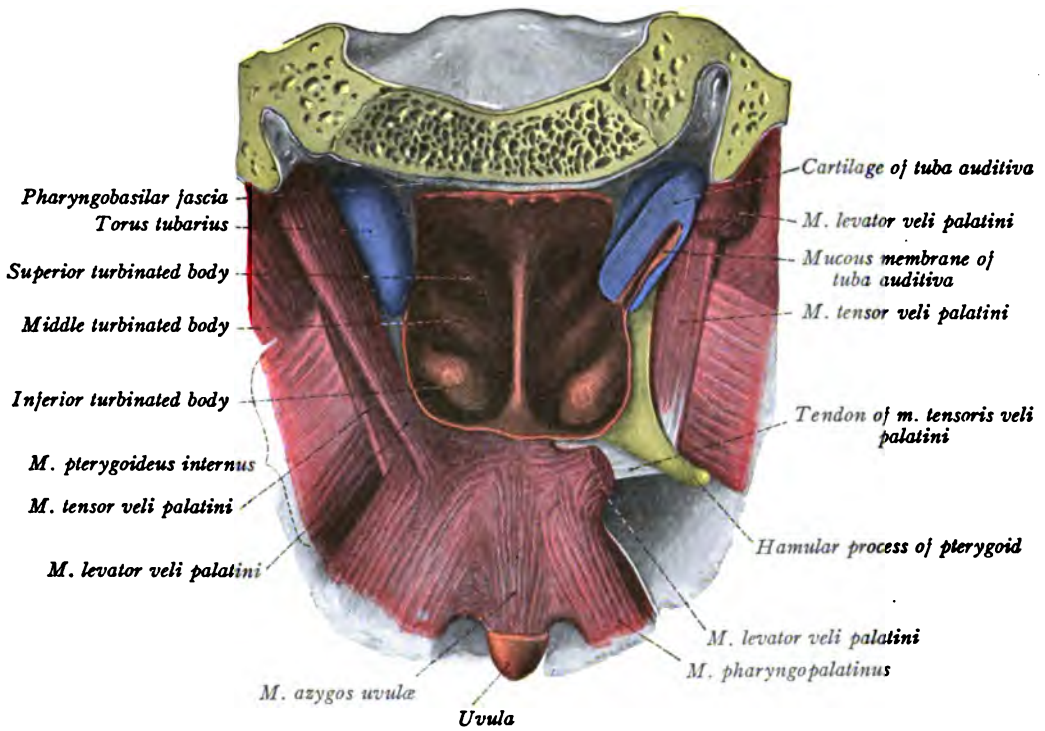

FIG. 329.—The palatine muscles seen from behind. On the right side the levator veli palatini has been removed and the tuba auditiva has been opened up. The mucous membrane has been cut at the margins of the choanæ.

Both the soft palate and the palatine arches contain muscles which are termed the palatal and pharyngeal muscles. They are the following:

The *azygos uvulæ* (*m. uvulæ*) is a small, unpaired, flat, elongated muscle which arises from the posterior nasal spine and terminates in the apex of the uvula, being situated nearer its posterior than its anterior surface. It not infrequently shows indications of being a paired muscle.

The *levator veli palatini* (*petrosalpingostaphylinus*) (Figs. 329 and 367) is a rather flat,

* The tonsillar tissue may not only entirely fill the tonsillar sinus but also extend upon the palatine arches, in which case the margins of the arches are not visible. The development of the palatine tonsil is subject to great individual variation.

FIG. 330.—The palate with the superior dental arch seen from below, showing the masticatory surfaces of the teeth and orifices of the palatine glands (*).

FIG. 331.—The inferior dental arch seen from above, showing the masticatory surfaces of the teeth.

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elongated, paired muscle which arises from a rough area near the carotid foramen upon the inferior surface of the petrous portion of the temporal bone (see Vol. I, p. 56), and from the lower margin of the posterior extremity of the cartilaginous portion of the tuba auditiva. It passes downward and inward in the outer wall of the nasal portion of the pharynx (see page 42) to the soft palate, where it spreads out in a flat lamina, the fibers of which interlace with those of the opposite muscle and with the pharyngopalatinus and azygos uvulæ (Fig. 327), forming with these muscles an almost continuous muscular plate, situated nearer the posterior than the anterior surface of the soft palate, being separated from the latter surface by a thick mass of glands.

The *tensor veli palatini* (*sphenosalpingostaphylinus*) (Figs. 329, 365, and 367) is a thin, flat, elongated muscle which arises by a short tendon from the spine of the sphenoid, from the scaphoid fossa of the internal pterygoid process, and from the outer wall of the cartilaginous tuba auditiva. It is intimately related with the internal surface of the pterygoideus internus, from which it is separated only by the buccopharyngeal fascia (Vol. I, p. 184). The levator veli palatini is more internal and further posterior than the tensor veli palatini, from which it is separated by fatty tissue.

Above the hamular process of the internal pterygoid plate the posterior surface of the muscle passes into a narrow tendon which winds around the hamular process in the sulcus hamuli and broadens out into an aponeurosis which passes almost horizontally across the soft palate to join its fellow of the opposite side. A small bursa, the *bursa m. tensoris veli palatini*, separates the tendon from the bone. The aponeurosis formed by the tendons of the two tensores veli palatini is attached to the posterior margin of the bony palate and is situated in front of the radiating fibers of the levatores.

The *glossopalatinus* (Figs. 327 and 352) is a flat muscular bundle which forms the anterior palatine arch. It arises from the transverse fibers of the tongue and inserts into its fellow of the opposite side in the base of the uvula, being also connected with the radiations of the levator veli palatini.

The *pharyngopalatinus* (Figs. 327 and 365) is better developed than the preceding muscle and forms the posterior palatine arch. It has manifold connections with the constrictors of the pharynx and may consequently be regarded as one of the pharyngeal muscles (see page 43). A portion of it comes directly from the constrictor medius and the remainder takes origin from the posterior margin of the thyreoid cartilage in connection with the inferior constrictor. In the soft palate the muscle has relations similar to those of the glossopalatinus and is particularly intimately connected with the radiation of the levator veli palatini.

The tensor veli palatini is innervated from the third division of the trigeminus through the otic ganglion; the remaining muscles are supplied from the pharyngeal plexus by fibers from the spinal accessory and pneumogastric nerves. The levator veli palatini and pharyngopalatini constrict the isthmus of the fauces.

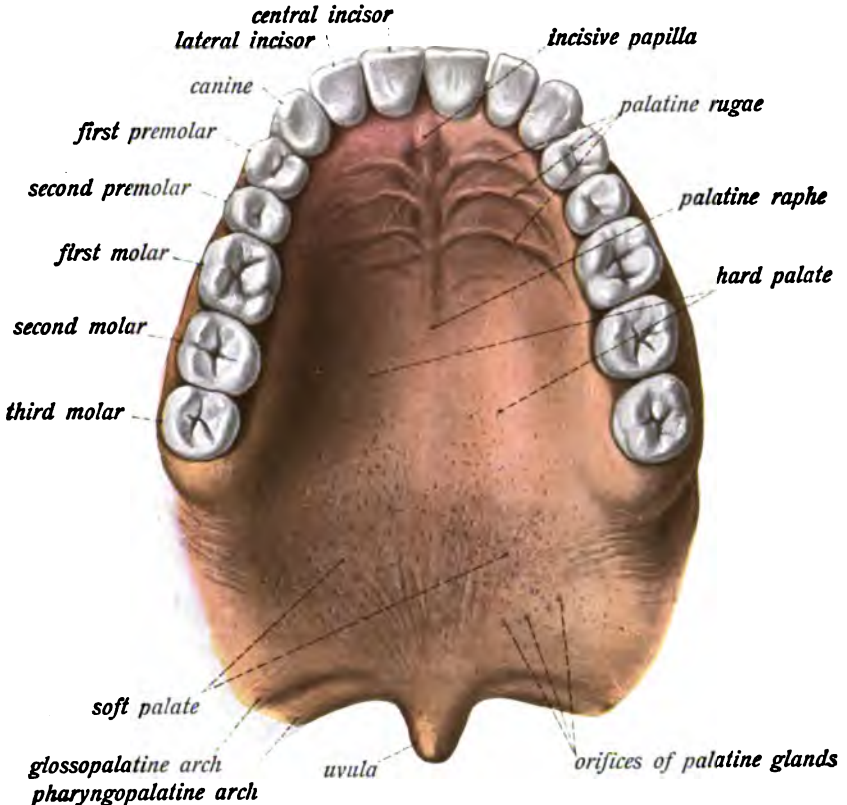

Fig. 330.

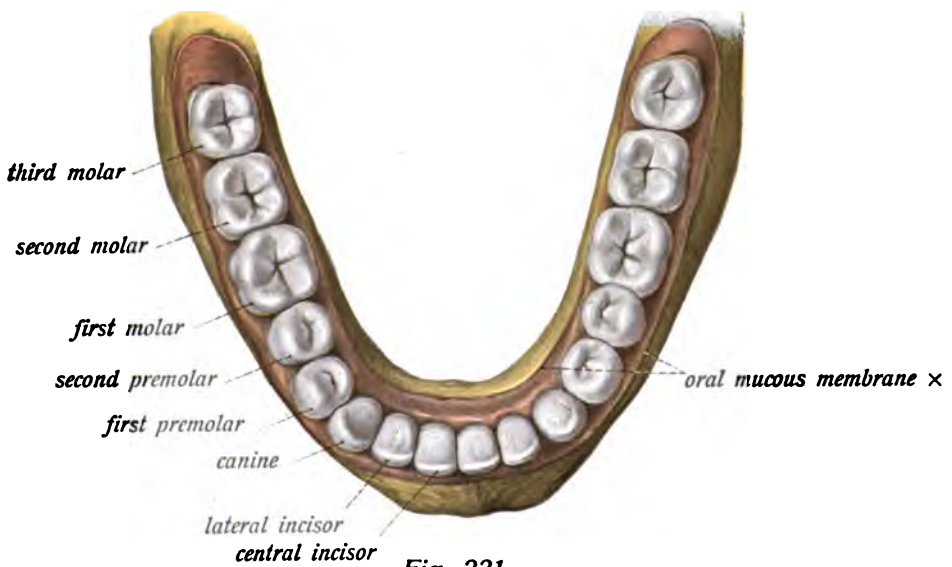

Fig. 331.

The oral mucous membrane varies in character and thickness in different localities. In the floor of the mouth, in the sublingual region, it is thin and is separated from the underlying tissue by a loose submucous layer. In the gums and hard palate it is especially thick, and the submucous layer in these situations is firmer and immovably connects the membrane with the periosteum. It is also thick upon the dorsum of the tongue, beneath which the submucosa becomes the lingual fascia (see page 34).

A considerable portion of the oral cavity is developed from the so-called oral invagination (see page 21), an ectodermal invagination which is at first separated from the endodermal intestinal tube by the pharyngeal membrane. At a certain period of development the oral invagination represents both the future oral and nasal cavities, but after the disappearance of the pharyngeal membrane and the union of the invagination with the anterior portion of the primitive gut, the oral and nasal cavities are separated by the paired palatal plates which develop from the superior maxillary processes and fuse in the median line. The lips are formed anteriorly during the formation of the face from the maxillary and mandibular processes of the first visceral arch.

THE TEETH.

The teeth (Figs. 330 to 349) are hard conical structures, whose roots are embedded in the alveoli of the jaws. The portion of the tooth surrounded by the gums is called the *neck* (*collum dentis*), while the portion projecting into the oral cavity is designated as the *crown* (*corona dentis*). The three chief constituents of a tooth are the *enamel* (*substantia adamantina*), the *dentine* (*substantia eburnea*), and the *cement* (*substantia ossea*) (Fig. 332). The enamel is found only in the crown, while the cement is present chiefly about the root, although it forms a very thin layer about the neck of the tooth, where the enamel and the dentine become thinner. The enamel has a white glistening surface with a bluish or yellowish shimmer, while the root of the tooth is slightly yellowish and dull.

In the crown of each tooth there may be recognized a masticatory surface directed toward its fellow in the opposite jaw, a labial or buccal surface directed toward the lip or the cheek respectively, a lingual surface in relation with the tongue, and two contact surfaces in apposition with the neighboring teeth.

The root of the tooth is single or multiple and is generally conically shaped (Fig. 332). At its apex is a foramen, the external orifice of the canal of the root, which extends throughout the length of the root, and in the region of the neck gradually dilates to a large cavity situated within the crown, the tooth cavity, also known as the *pulp-cavity* because it is filled by a soft non-calcified tissue, the dental pulp. The shape of the pulp-cavity is in general a reproduction of that of the entire tooth, but it not infrequently presents fine irregular ramifications.

The entire set of teeth (Figs. 330 and 331), thirty-two in number in the adult, is known as the denture, and is arranged in an upper and a lower row, the *superior* and the *inferior dental arch*. The upper row is fixed in the alveoli of the superior maxilla and the lower row in those of the mandible, the form of articulation being that known as gomphosis. The bone and the tooth are separated by a thin layer of tissue common to both structures, the alveolar periosteum (Fig. 332), which in the vicinity of the neck of the tooth is also designated the *circular ligament*. The teeth of the two rows resemble each other in shape and size, although the similarity is not absolute, and the number of teeth in each row is the same, namely, sixteen.

The teeth of each jaw are divided into four different groups according to their shape, the

incisors, the *canines*, the *premolars*, and the *molars*, and each of the four varieties possesses such well-defined characteristics that transitional types do not occur, although differences are observed

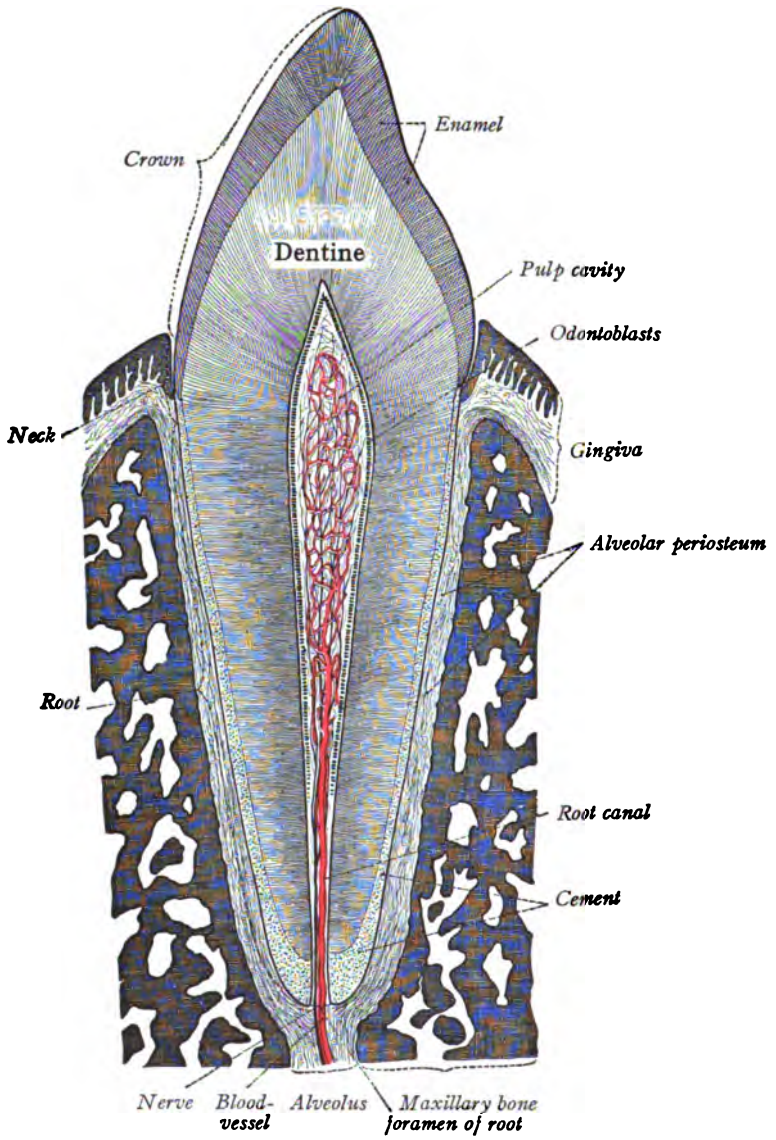

FIG. 332.—Longitudinal section of a tooth in its alveolus (diagrammatic).

between individual teeth of the same group, particularly between those of the upper and lower jaw.

In each jaw there are four incisors, two canines, four premolars and six molars, the arrange-

ment of the individual groups being the same in both jaws. The incisors are placed most anteriorly, the two central ones being in contact in the median line; then come on either side a canine, two premolars, and three molars, these last being situated most posteriorly.

The human dental formula is consequently as follows:

M.	Pm.	C.	I.	:	I.	C.	Pm.	M.	
3	2	1	2	:	2	1	2	3	= 32
3	2	1	2	:	2	1	2	3	

The *incisor teeth* (Figs. 333 to 337) have flat, chisel-shaped crowns, convex on the labial surface and concave on the lingual surface, and thicker but narrower at the base and broader and thinner at their free margins. Upon the labial surface are three longitudinal ridges which are not always distinctly marked, and upon the cutting-edge of a recently erupted tooth these ridges terminate as small projections which rapidly disappear as a result of attrition. The inner corners of the cutting-edge are usually sharper than the outer ones, these being generally rounded off.

The crowns of the incisors lie in the frontal plane and present an inner and an outer surface of contact. The roots are rounded, of average length, and usually exactly straight; those of the lateral incisors are somewhat shorter and slightly flattened.

The upper incisors are always larger than the lower, and the upper central incisor is always larger than the lateral, but in the lower jaw this relationship is reversed. The relative size of the incisor teeth is subject to marked individual variations.

The *canine teeth* (Figs. 333 to 336) are situated between the incisors and the premolars and are of an elongated conical form. Their large, thick, irregularly conical crowns are approximately in the frontal plane, so that they present a labial and a lingual surface, and an inner and an outer surface of contact. The labial surface is markedly convex, and the lingual is characterized by a slight elevation. The roots are very long and conical, although they are distinctly flattened, particularly in the lower jaw. In consequence of their long roots the canines are the longest teeth of the entire dentition, and, moreover, their crowns are higher than those of the other teeth. The cusp of the crown is blunt and not exactly in the middle of the tooth, but somewhat nearer its inner side.

The *premolars* (Figs. 333 to 336) are characterized by bicuspid crowns which are flattened from before backward, and consequently present an anterior and a posterior contact surface, a convex lingual surface, and a larger convex buccal surface. The cusps or tubercles are separated by an almost sagittal groove (Figs. 329 and 330) in such a manner that the lingual cusp is smaller than the buccal one; indeed, the lingual cusp of the lower first premolar is usually poorly developed, but that of the lower second premolar is usually double, so that this tooth, which is usually the largest of the premolars, is frequently tricuspid.

The roots of the lower premolars are always single, of medium length, and distinctly flattened. Those of the upper premolars vary considerably; that of the first is usually double or at least bifid, while that of the second is generally markedly flattened or furrowed and usually possesses a double root canal.

FIG. 333.—The upper and lower teeth seen from the labial or buccal surface.
c, Canine; *in*, incisor; *i*, inferior; *l*, lateral; *m*, medial; *mo*, molar; *pr*, premolar; *s*, superior.

FIG. 334.—The upper and lower teeth seen from the lingual surface.

FIG. 335.—The upper and lower teeth seen from their contact surfaces.

FIG. 336.—The complete deciduous dentition of a three-year-old child, seen from the labial or buccal surface.
c, Canine; *d*, deciduous; *i*, inferior; *l*, lateral; *m*, medial; *mo*, molar; *pr*, premolar; *s*, superior.

FIG. 337.—The lower lateral deciduous incisor, the lower deciduous canine and the two lower deciduous molars of a two-year-old child. The teeth of the upper row are seen from their labial or buccal surfaces, those of the lower row from the same surface and at the same time from below. The roots are not yet completely ossified and represent four stages of development.

FIG. 338.—Upper and lower teeth of the skull of a twenty-eight-year-old man in their normal position.

FIG. 339.—Dentition of a child in the first year. The imperfect teeth which have not yet broken through have been exposed by chiseling away the anterior alveolar wall.

FIG. 340.—Deciduous dentition of the upper jaw of a four-year-old child.

FIG. 341.—Deciduous dentition of the lower jaw of a four-year-old child.

FIGS. 342 and 343.—Skull of a five-year-old child with the deciduous and permanent teeth seen from in front. The permanent teeth and the roots of the deciduous ones have been exposed by chiseling away the anterior alveolar wall.

All the *molars* (Figs. 333 to 335) possess a number of cusps and roots, and their crowns are low and characterized by their large circumference. The number of the roots and the position of the cusps are different in the upper and lower jaw, the upper molars being usually somewhat

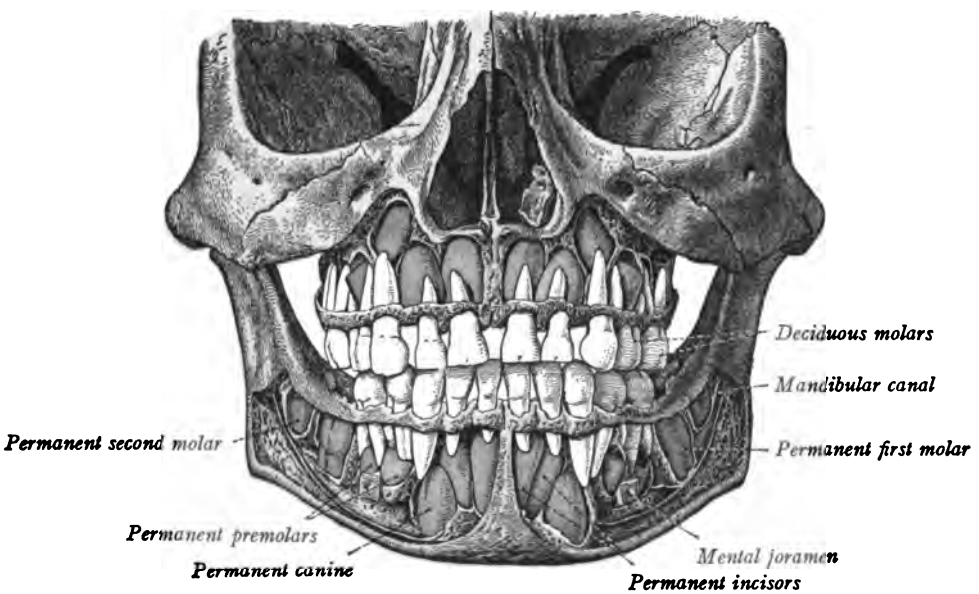

FIG. 343.

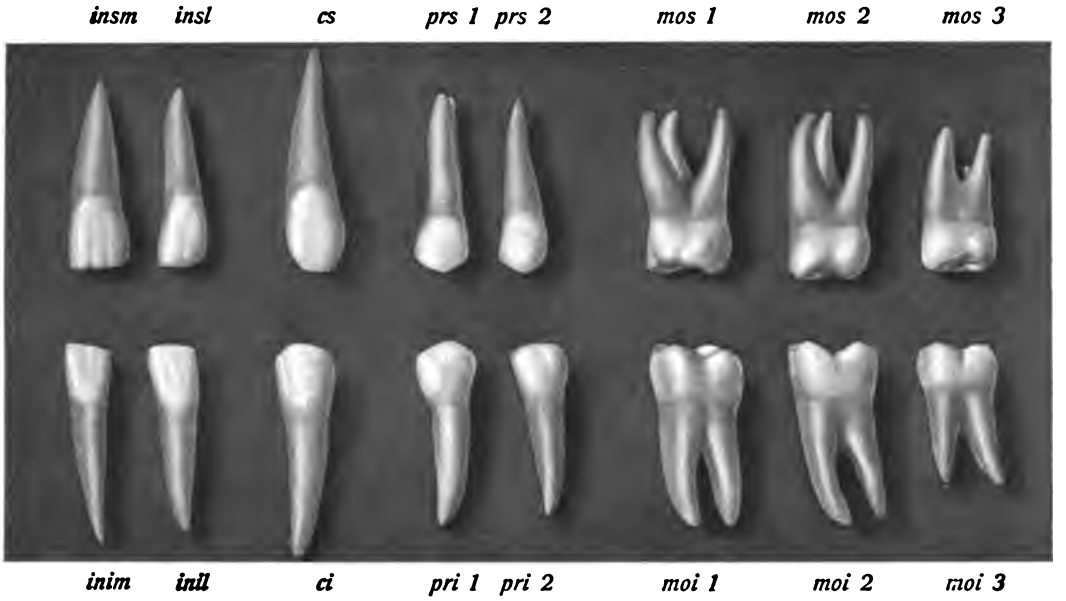

Fig. 333.

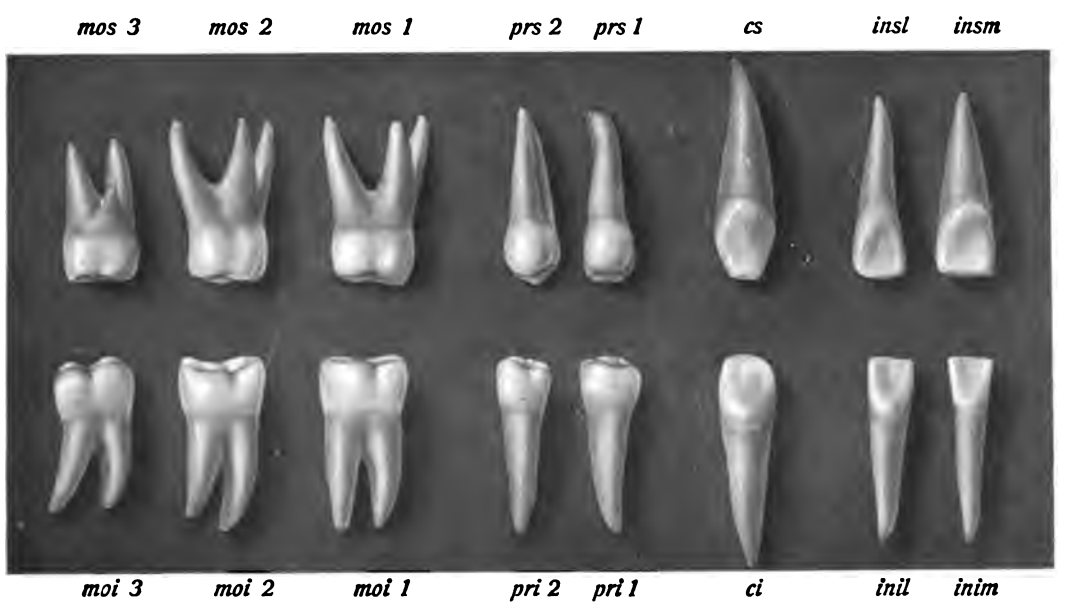

Fig. 334.

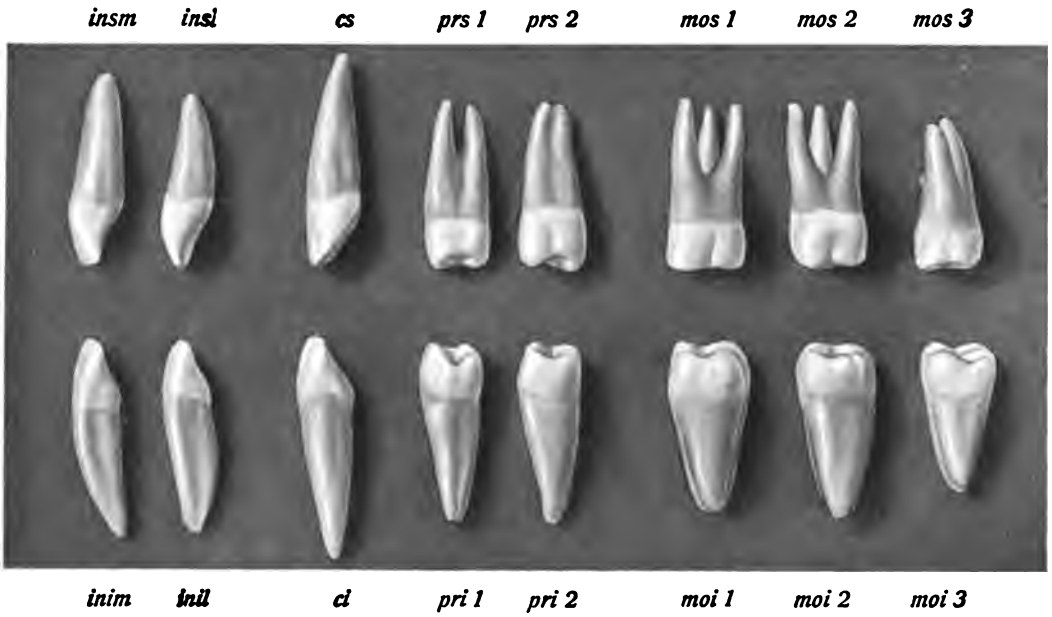

Fig. 335.

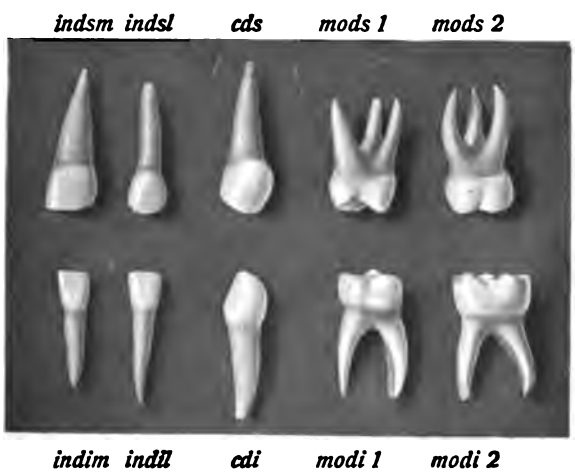

Fig. 336.

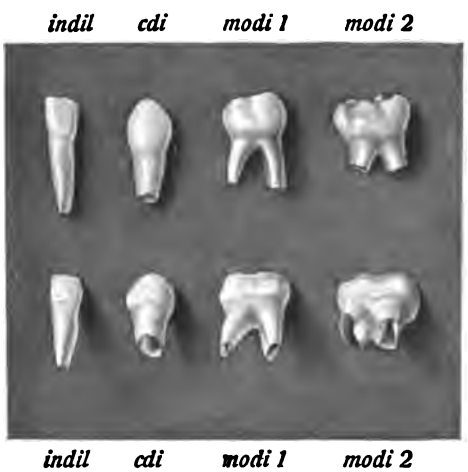

Fig. 337.

Fig. 338.

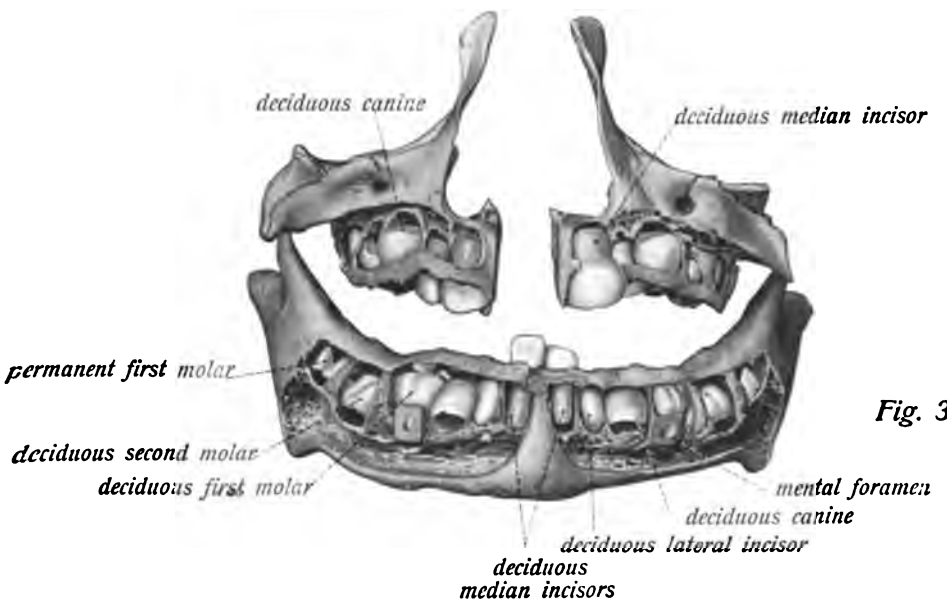

Fig. 339.

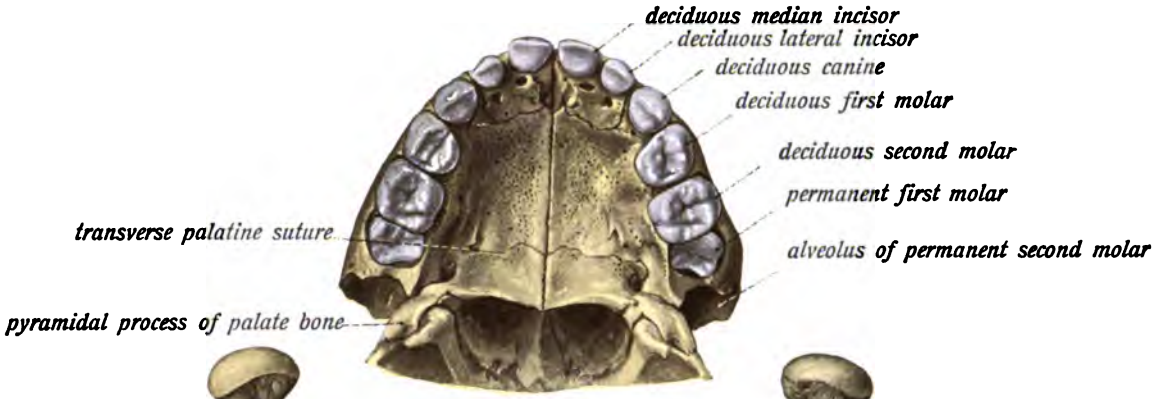

Fig. 340.

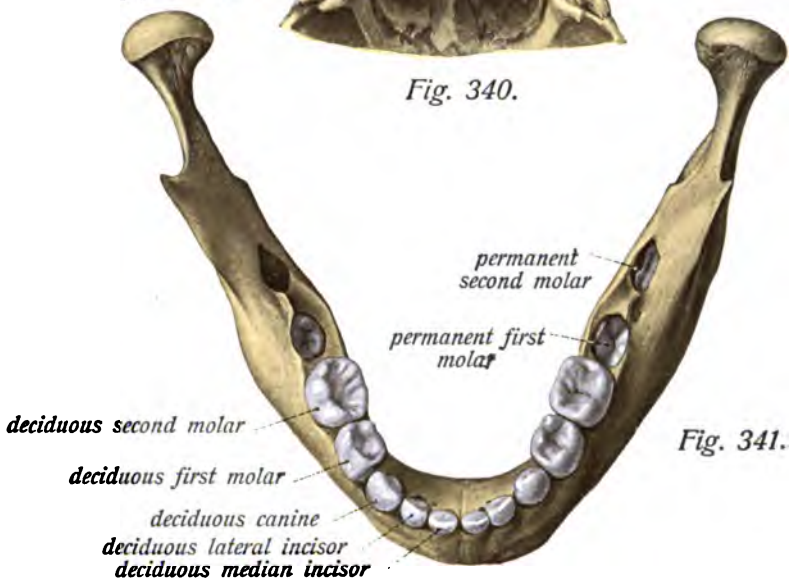

Fig. 341.

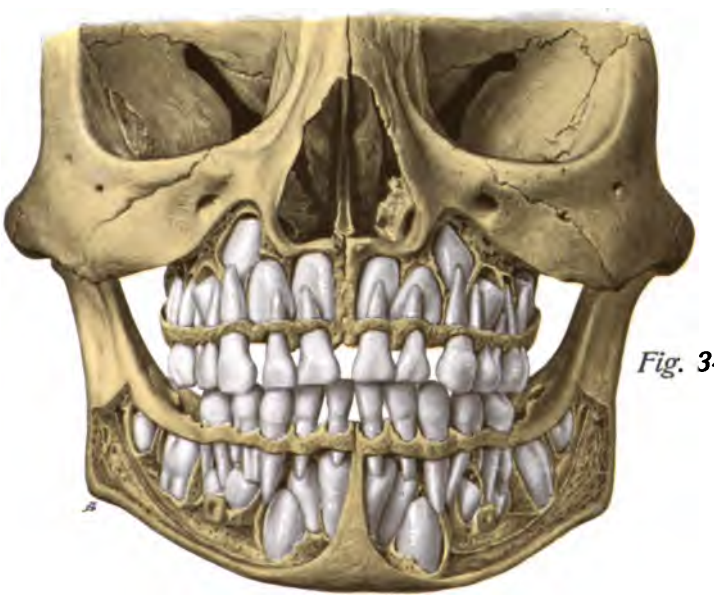

Fig. 342.

smaller than the lower and having three roots, while the lower ones have but two. The first molar in each jaw has the largest and highest crown, while the third has the smallest and the lowest, and, consequently, as a rule, the first lower molar is the largest of the group.

The cusps of the molar teeth are four, rarely five in number, two being lingual and two buccal. In the lower molars the four cusps are separated by a tolerably regular cruciform groove (Fig. 331), and since the lingual cusps are higher than the buccal ones, the lower molars look as though they were composed of two fused premolars. The lower first molar usually has five cusps, three buccal and two lingual. In the upper molars the buccal cusps are higher than the lingual and the separating sulci have the form of a slanting H (Fig. 330), so that the lingual and buccal cusps hold an oblique relation to each other. Irregularities in the number and arrangement of the cusps are common, particularly in the third molar (wisdom tooth, see below), which may have from three to five cusps. As in the case of the premolars, the frontal surfaces of the crowns of the molars are in relation with each other, so that an anterior and a posterior surface of contact may be recognized. Both the lingual and the buccal surfaces of the molar crowns are convex, and both surfaces of the upper molars (at least of the first) have a longitudinal sulcus, while in the lower molars only the buccal surface presents this marking.

The lower molars have two roots, an anterior and a posterior, which are sometimes grooved. They are of moderate length, compressed in the frontal plane, and their apices are usually bent backward. The grooves are an indication that each root is formed by the fusion of two halves, and in rare instances more than two roots may consequently be present.

The upper molars have three conical roots the ends of which are also bent backward. Two are buccal and one is lingual (or palatine, *i. e.*, directed toward the palate, posterior). All three roots are well developed in almost all cases in the first upper molar, while they may be more or less fused in the second. The latter condition is the rule in the third.

The third molars do not make their appearance until from the twentieth to the twenty-fifth year, and have consequently been called the "wisdom teeth" (*dentes serotini*). They are only rudimentary structures in civilized nations, but in ancient skulls and in those of many savage races they are well developed and frequently but slightly smaller than the second molars. The upper wisdom tooth is always much smaller than the lower, and its roots are usually fused together, although the original number is frequently indicated, particularly by the number of the root-canals. There are frequently only three cusps present. The lower wisdom tooth usually has two short roots and the crown seems better developed than that of the upper jaw.

The upper teeth, particularly the front ones, are normally directed slightly outward, those of the lower row slightly inward, so that the somewhat larger superior dental arch overlaps the smaller inferior one throughout its entire circumference. When the dental arches are in apposition (the so-called position of articulation of the teeth) every tooth is opposed to two teeth of the other jaw (Fig. 338), except in the cases of the upper third molars, which are in contact only with the lower third molars; this condition is due to the front teeth of the upper row being considerably wider than those of the lower.

In contrast to the thirty-two *permanent teeth* forming the adult dentition is the deciduous or "milk" dentition of childhood (Figs. 338 to 340), which contains but twenty *deciduous teeth*, namely, eight incisors, four canines, and four molars (Figs. 335 and 336).

FIG. 344.—Skull of a five-year-old child, prepared as in Fig. 341, seen from the side.
FIG. 345.—Upper and lower jaws of a nine-year-old child, prepared as in Fig. 341, seen from the side.
FIG. 346.—The same preparation as Fig. 343, seen from in front.
FIG. 347.—Upper and lower jaws of a twenty-year-old man, prepared as in Fig. 341. All the teeth, except the lower third molars have broken through.

The dental formula for the deciduous teeth is consequently:

$$\frac{\begin{matrix} M & C & I & : & I & C & M \\ 2 & 1 & 2 & : & 2 & 1 & 2 \end{matrix}}{\begin{matrix} 2 & 1 & 2 & : & 2 & 1 & 2 \end{matrix}} = 20$$

The deciduous incisor and canine teeth, although smaller, correspond to those of the permanent denture not only in number but likewise in peculiarities of shape. They are also found in the same situation as the permanent teeth of the same name, while the deciduous molars appear at the site of the subsequent premolars. They resemble the permanent molars in having several roots, and in being provided with several cusps. The second (posterior) milk-molars are always larger than the first. The upper molars, like those of the permanent dentition,* have three roots, two buccal and one lingual, but these roots present a marked tendency toward fusion. The lower molars have two roots, and the crowns of both the upper and lower teeth have from four to five irregularly situated cusps.

The teeth of the lower jaw erupt normally before those of the upper (Figs. 339 and 349). The lower central incisor makes its appearance usually in the sixth or seventh month and is soon followed by the corresponding tooth in the upper jaw (in the seventh to the eighth month). The lateral incisors usually erupt in the eighth to the twelfth month, and the lower first molars in the twelfth to the sixteenth month, followed several months later by those of the upper jaw. After the first molars come the canines (sixteenth to twentieth month) and finally the second molars (twentieth to thirtieth month).

The milk-teeth are gradually replaced by the permanent dentition, so that during a certain period in childhood teeth of both sets may be seen alongside of each other, and at this stage the jaws consequently contain a large number of teeth in different stages of development (Figs. 342 to 348). The first permanent tooth to erupt is the lower first molar, which makes its appearance from the fifth to the eighth year and is speedily followed by the corresponding tooth in the upper jaw. The deciduous central incisors are not replaced until the sixth to the ninth year, and the lateral from the seventh to the tenth year. The first premolars erupt from the ninth to the thirteenth year, the permanent canines from the ninth to the fourteenth year, and the second (posterior) premolars from the tenth to the fourteenth year, these last being almost immediately followed by the second molars. The third molars frequently do not make their appearance until

* The upper second milk molar almost completely resembles the corresponding permanent tooth, while the upper first molar is subject to great variation in its shape and in the position of its cusps, which are situated upon two ridge-like prominences (a lingual and a buccal).

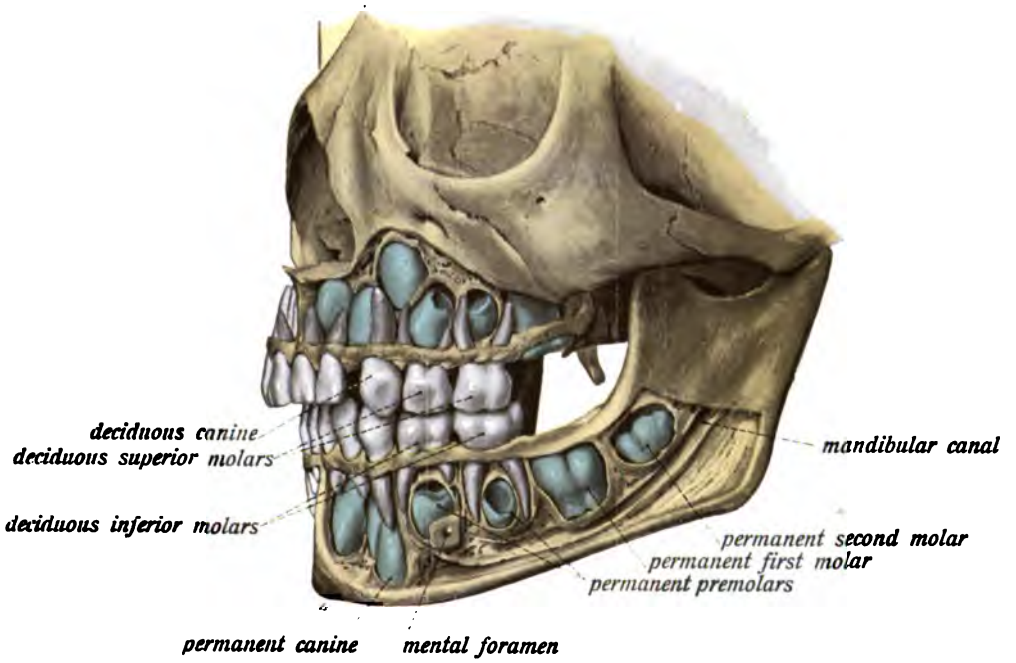

Fig. 344.

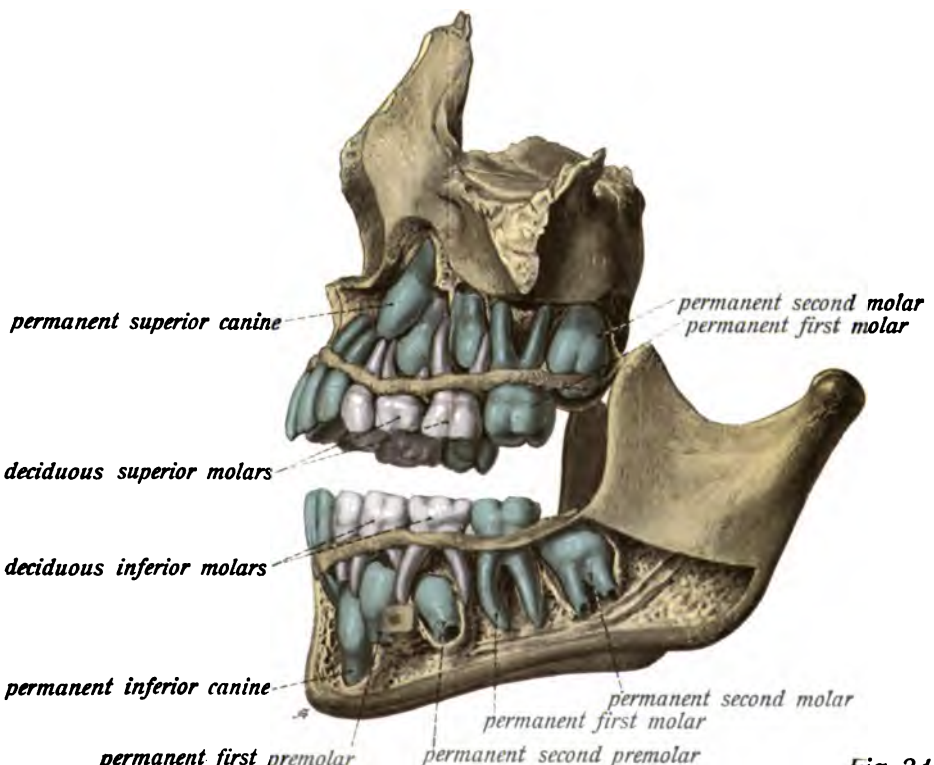

Fig. 345.

quite late (the sixteenth to the fortieth year). The upper premolars usually erupt before the lower, but with this exception the teeth of the lower jaw always appear first.

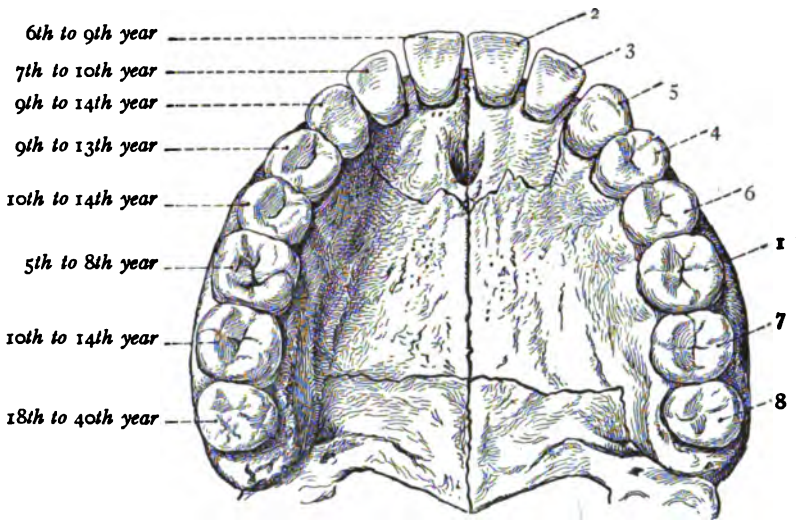

FIG. 348.—Figure showing the time of eruption of the permanent teeth.

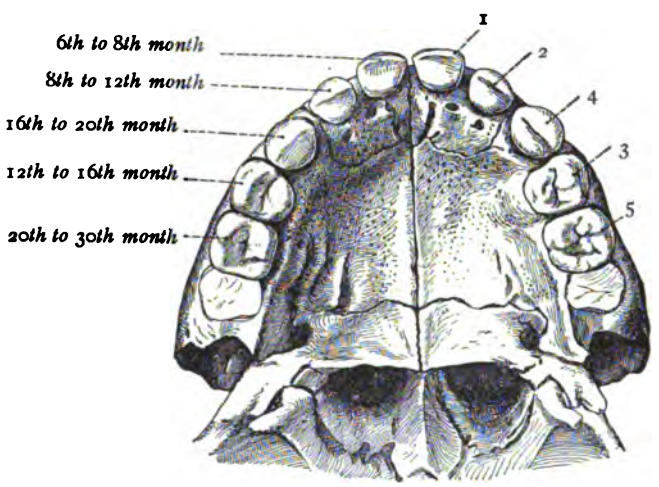

FIG. 349.—Figure showing the time of eruption of the deciduous teeth.

[In these two figures the numbers to the left indicate the time of eruption, those to the right the order of succession.]

The crown of the tooth is formed first and the so-called enamel-organ takes part in its formation only, since it alone possesses enamel. The roots are formed by the dental papillæ and are not complete when the eruption of the tooth occurs and the cement and the circular ligament are formed by the wall of the dental sac. During the development of the tooth the pulp-cavity and particularly the root-canals are relatively large (Fig. 337).

FIG. 350.—View of the sublingual region, the mouth being widely open and the tip of the tongue elevated

FIG. 351.—View from above of the tongue removed from the body.

FIG. 352.—The superficial layer of the musculature of the tongue seen from the right side. The mandible has been divided immediately to the right of the median line.

FIG. 353.—The deeper layer of the musculature of the tongue seen from the right side. The hyoglossus has been cut and the geniohyoideus removed.

The roots of the deciduous teeth are eventually absorbed by the action of osteoclasts, and their crowns either fall out or are broken off mechanically.

Dental anomalies are not common, although supernumerary teeth may be observed and normal teeth may be wanting. The upper lateral incisors are most frequently absent, in which case the central incisors are correspondingly enlarged, and supernumerary teeth most frequently occur in the incisor set. Anomalies of position are common. Very rarely there is observed the beginning of a third dentition.

THE TONGUE (LINGUA).

The *tongue* (Figs. 329 and 350 to 357) is a muscular organ which almost entirely fills the oral cavity. It is covered with mucous membrane and consists of three chief portions: the middle and largest portion, attached to the floor of the mouth, the body; the anterior portion, projecting into the oral cavity, and completely clothed by mucous membrane, the tip; and the posterior portion, attached to the hyoid bone and epiglottis, the root.

In the body of the tongue there may be recognized an inferior attached surface and a convex superior surface or dorsum which is covered throughout its entire length by the oral mucous membrane. The lateral margin of the tongue is rounded; in its anterior part it is free, while posteriorly it is continuous with the soft palate (the glossopalatine arch, see page 24).

When the mouth is closed, the larger anterior portion of the dorsum of the tongue is applied to the palate; its posterior portion borders upon the pharynx at the isthmus of the fauces (see page 42). The junction of the body with the root of the tongue is indicated upon the dorsum by a depression, the *foramen cæcum* (Fig. 351), which leads into a short blind mucous canal, the *lingual duct*, an embryonic rudiment which in the adult exhibits only the orifices of a few mucous glands. From the foramen cæcum the circumvallate papillæ (see below) extend laterally, being arranged like a letter V, the apex of which is directed posteriorly and is formed of the foramen cæcum itself. Parallel and just posterior to the circumvallate papillæ there is frequently a groove, the *sulcus terminalis*, which indicates the dividing-line between the body and the root of the tongue. If this be absent, the row of circumvallate papillæ forms the boundary.

The root of the tongue is connected with the epiglottis by three folds of mucous membrane, a single *median glosso-epiglottic fold* and two *lateral glosso-epiglottic folds*. Between these folds upon either side of the median line there is a roundish pit which is known as the *epiglottic vallecula*.

In the tongue two chief constituents, the mucous membrane and the musculature, may be recognized. Upon the under surface of the tongue these two constituents are but loosely attached to one another, but upon the dorsum the attachment is firmer, the terminal prolongations of the muscle fibers inserting directly into the *lingual fascia* (Fig. 355), a layer of firm connective tissue situated immediately beneath the mucous membrane.

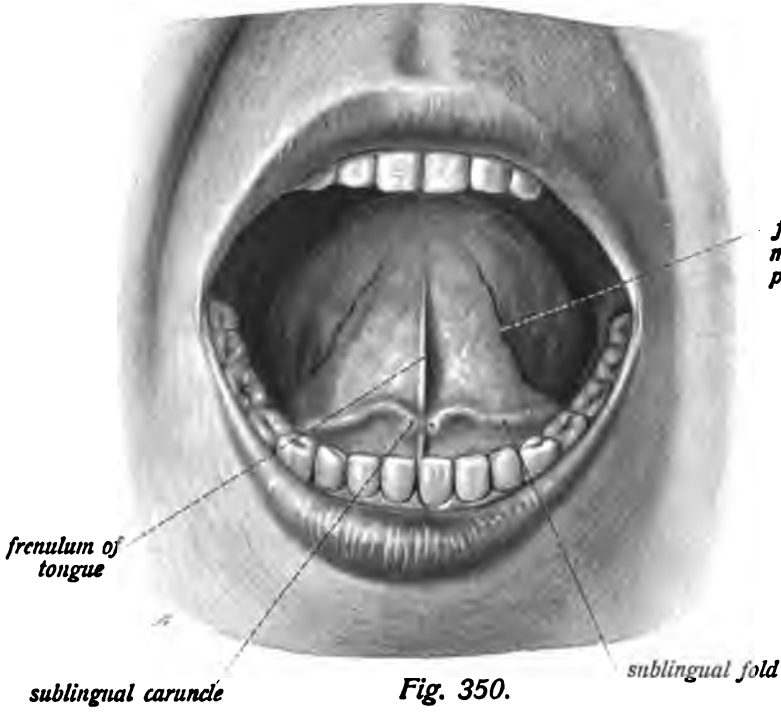

Fig. 350.

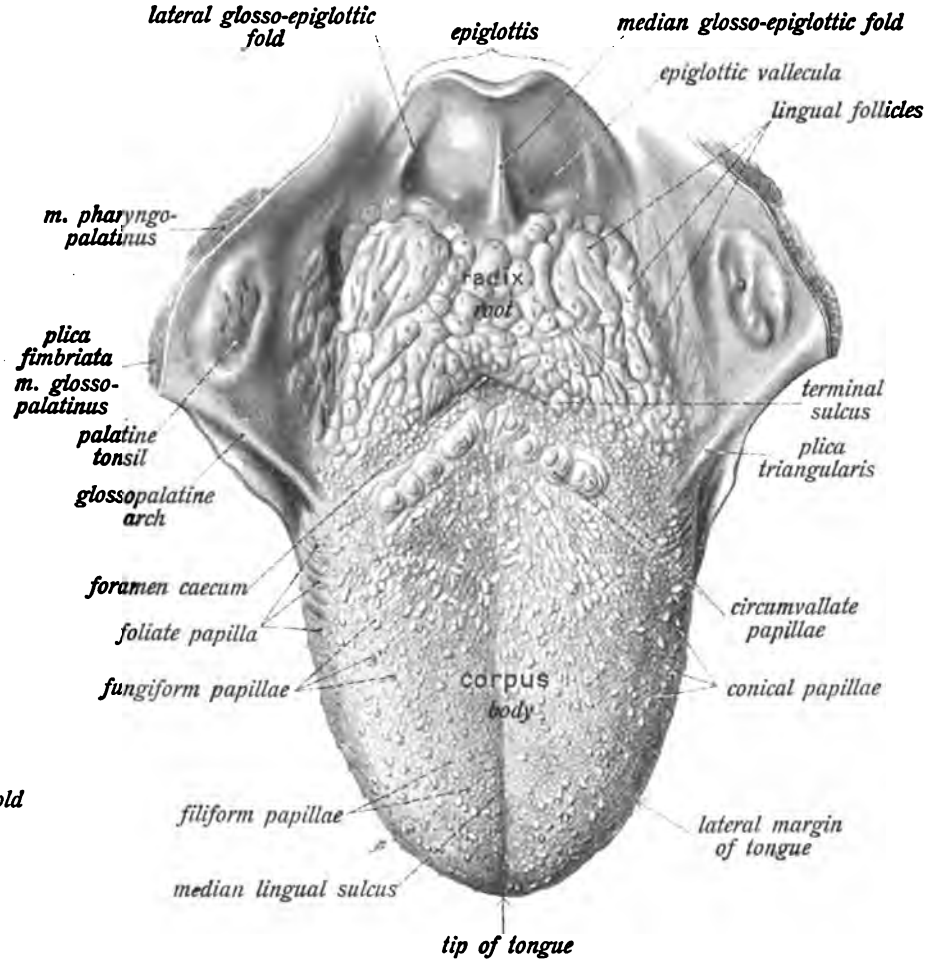

Fig. 351.

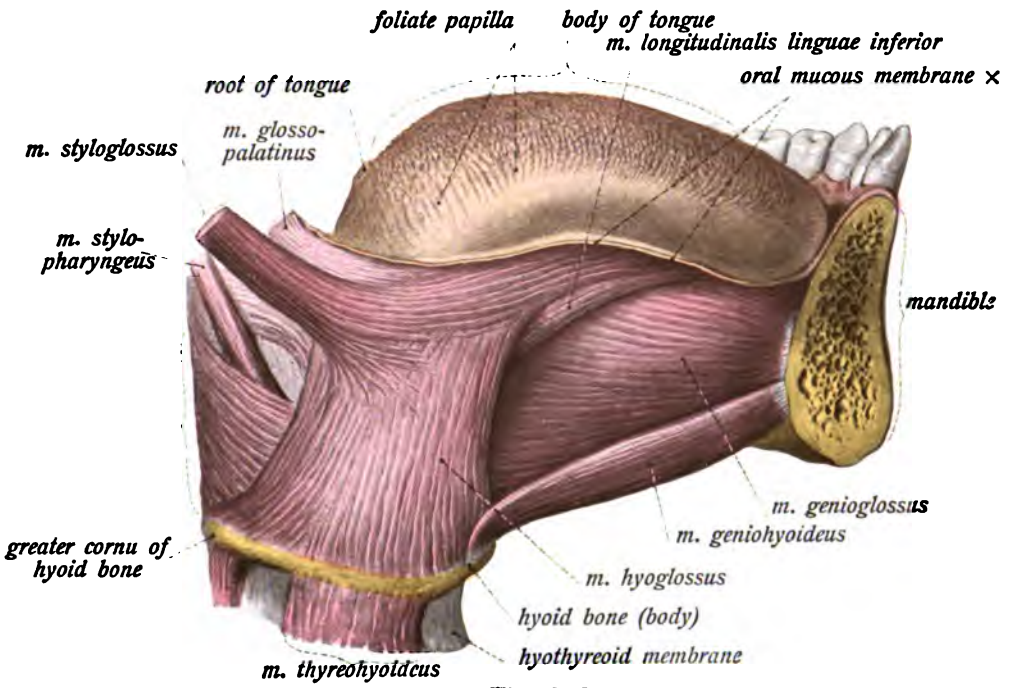

Fig. 352.

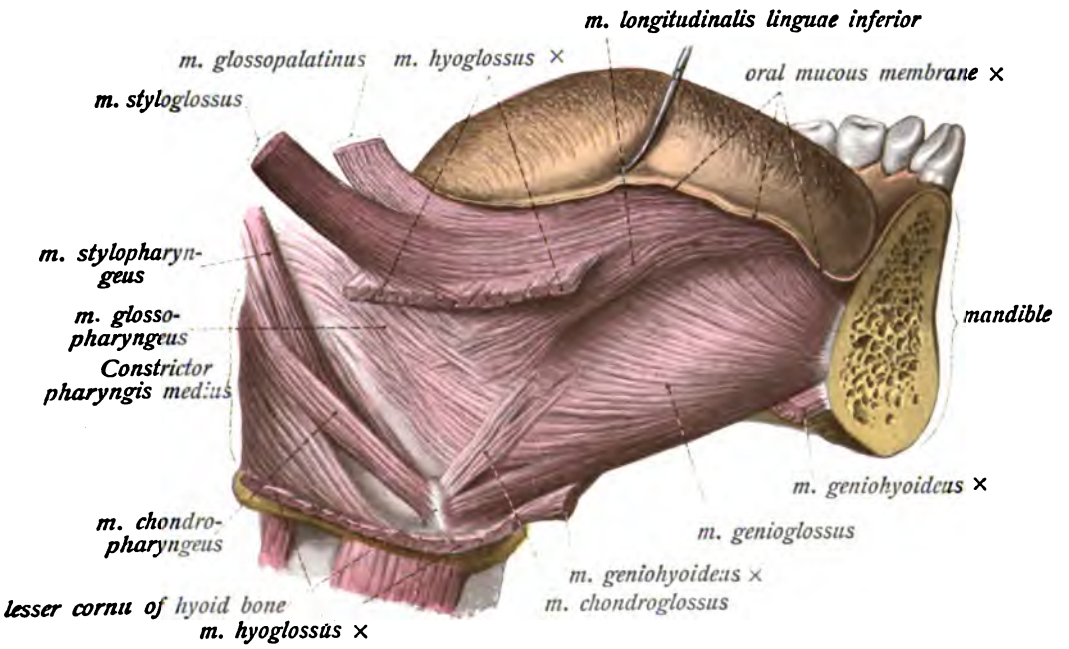

Fig. 353.

FIG. 354.—The musculature of the tongue seen from below.
The genioglossi have been separated from the mandible and the right hyoglossus has been cut.
FIG. 355.—Median longitudinal section of the tongue.
FIG. 356.—Transverse section of the middle portion of the tongue.
FIG. 357.—Transverse section of the tip of the tongue.

The sublingual mucous membrane (Fig. 350) is smooth and thin and exhibits the ordinary characteristics of the oral mucous membrane (see page 27). In the median line, beneath the tip of the tongue, it presents a fold, the *frenulum*, to either side of which is found a *plica fimbriata* (Figs. 350 and 354), which is always well developed in the newborn and less distinct, though rarely entirely absent, in adult life. This fold is always lobulated in the newborn, and usually so in the adult, and gradually disappears as it runs backward and outward from the anterior extremity of the frenulum. In the floor of the mouth just beside the anterior portion of the lateral margin of the tongue, and running obliquely from behind forward and inward, is a fold, the *sublingual fold* (Fig. 350), which is produced by the underlying secretory duct of the submaxillary gland (see page 39) and usually contains the orifices of the lesser sublingual ducts. The two folds converge toward the posterior extremity of the frenulum, in the immediate proximity of which they terminate in a small elevation, the *sublingual caruncle*, which marks the orifice of the submaxillary duct.

THE LINGUAL MUSCLES.

The muscles of the tongue (Figs. 352 to 357) are divided into two groups: (1) Those which take origin from the skeleton (skull and hyoid bone) and insert into the tongue; (2) those muscles which belong solely to the tongue, both the origin and insertion being situated within the organ. The first group is composed of the genioglossus, the hyoglossus (chondroglossus), and the styloglossus.

The *genioglossus* (Figs. 352 to 356) is the strongest of all the lingual muscles and arises by a tendon from the mental spine (superior genial tubercle) of the mandible. It is a paired muscle and is situated just to one side of the median line so that the internal surfaces of the two muscles are in apposition. The majority of the fibers terminate in the lingual mucous membrane, or rather in the lingual fascia, but the most inferior fasciculi pass almost horizontally backward immediately above the geniohyoid and insert into the body of the hyoid bone and into the epiglottis (by means of elastic tendinous fasciculi). The adjacent fibers also at first pass backward from their point of origin, but soon curve sharply upward to insert into the mucous membrane of the dorsum, while the most anterior fibers pass almost vertically upward and then curve slightly forward into the tip of the tongue.

The *hyoglossus* (Figs. 352 to 354) is a flat quadrangular muscle situated at the side of the floor of the mouth, and arises from the body and greater and lesser cornua of the hyoid bone. The portion coming from the lesser cornu, which is known as the *chondroglossus* (Fig. 353), is not always present. The portion of the muscle arising from the body of the hyoid bone is the strongest, that originating from the greater cornu being considerably flatter, and the fasciculi from both origins pass obliquely upward and forward into the tongue, where they pass between the longi-

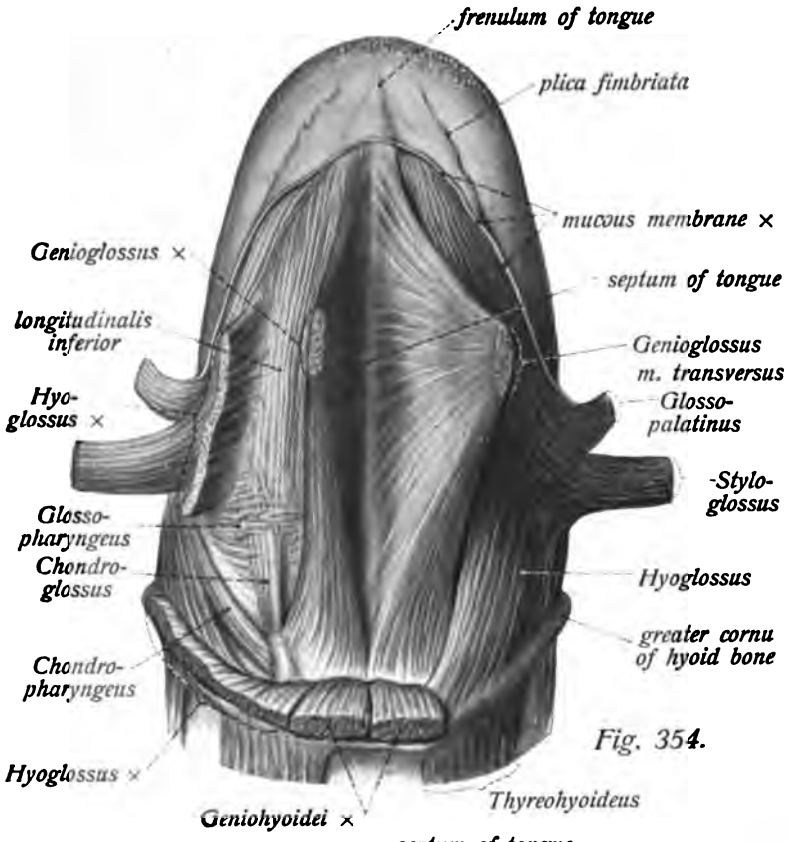

Fig. 354.

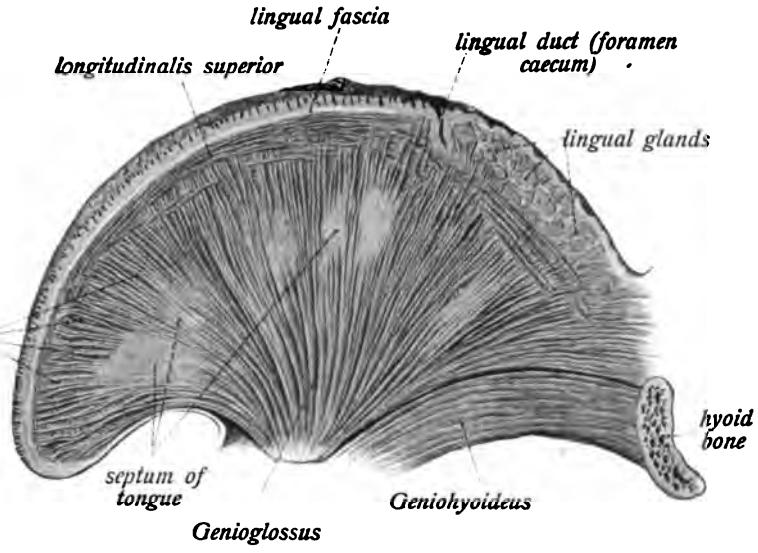

Fig. 355.

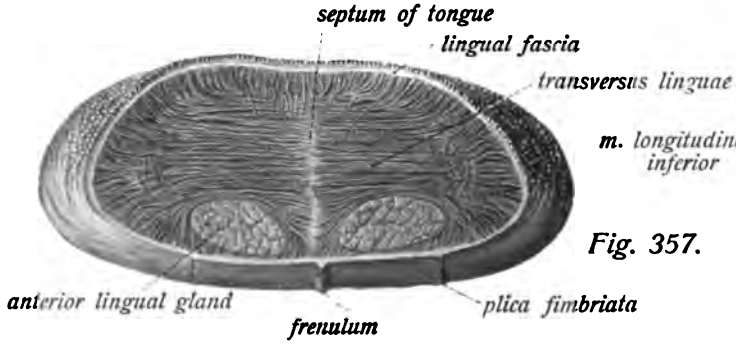

Fig. 357.

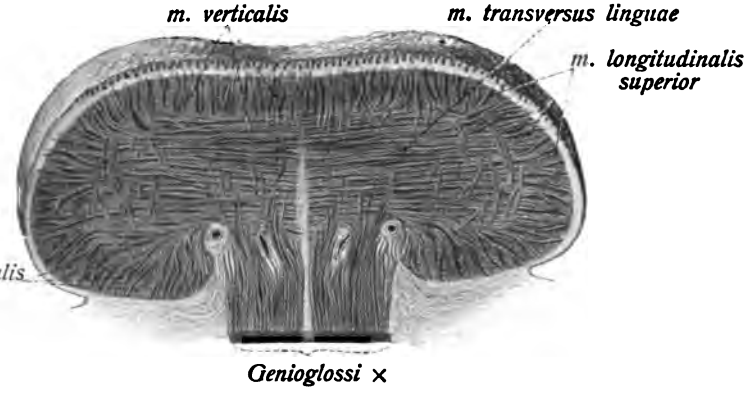

Fig. 356.

FIG. 358.—The parotid gland in position.

FIG. 359.—The submaxillary and sublingual glands.

The mandible has been divided in the median line and the tongue has been removed. * = A flat process of the submaxillary gland which extends above the mylohyoid muscle.

FIG. 360.—The submaxillary gland in position in the submaxillary fossa.

FIG. 361.—The submaxillary and sublingual glands seen from the submaxillary fossa.

The anterior belly of the digastric has been removed, the mylohyoid has been divided and turned aside, and the submaxillary gland is tilted backward.

The latter are the parotid, the submaxillary, and the sublingual. They possess excretory ducts of varying lengths, which empty into the oral cavity.

The *parotid* (Figs. 359, 360, 364, and 365), the largest oral salivary gland,* is of a flattened irregular triangular shape and is situated in front of the external ear in the parotideo-masseteric region and partly also in the retromandibular fossa. Its slightly convex external surface is covered by the skin, the prolongations of the platysma (and risorius), and the parotideo-masseteric fascia, while the slightly concave internal surface rests chiefly upon the masseter.

The anterior portion of the gland is much the thinner, and the anterior somewhat concave margin is slightly beveled and lies upon the external surface of the masseter. The inferior margin is directed somewhat posteriorly, so that it forms an acute angle with the anterior margin, this tip of the gland being situated in the neck and sometimes extending as far down as the submaxillary gland. The inferior and posterior margin rests upon the anterior margin of the sternocleidomastoid and the superior margin is generally irregular and is in relation with the zygoma and the external auditory meatus.

The posterior portion of the gland, situated behind the posterior margin of the masseter, covers the outer surface of the ramus of the lower jaw, and its *retromandibular process* (Fig. 366) extends behind the ramus to come into relation with the internal pterygoid, the posterior belly of the digastric, and the muscles coming from the styloid process. This glandular process usually also reaches as far as the internal carotid artery and the internal jugular vein.

The parotid gland is traversed by the branches of the facial nerve which are situated nearer the internal than the external surface and form the parotid plexus within its substance. The upper branches of the external carotid, particularly the superficial temporal and some of its ramifications, as well as the posterior facial (temporo-maxillary) vein, may also be more or less enveloped by the lobules of the gland.

The duct of the parotid gland, the *parotid duct* (*ductus Stenoni*) (Fig. 358), appears at the upper portion of the anterior margin of the gland and passes almost transversely across the masseter, bends just in front of its anterior margin, and passes through the fatty tissue in this situation (the buccal fat pad) and the buccinator to the buccal mucous membrane which it perforates obliquely. The orifice of the duct is in the vestibulum oris and appears as a rounded slit opposite the upper second molar tooth.

Several small conglomerations of lobules are very frequently observed about the parotid

* Oral salivary gland in contrast to the abdominal salivary gland, the pancreas.

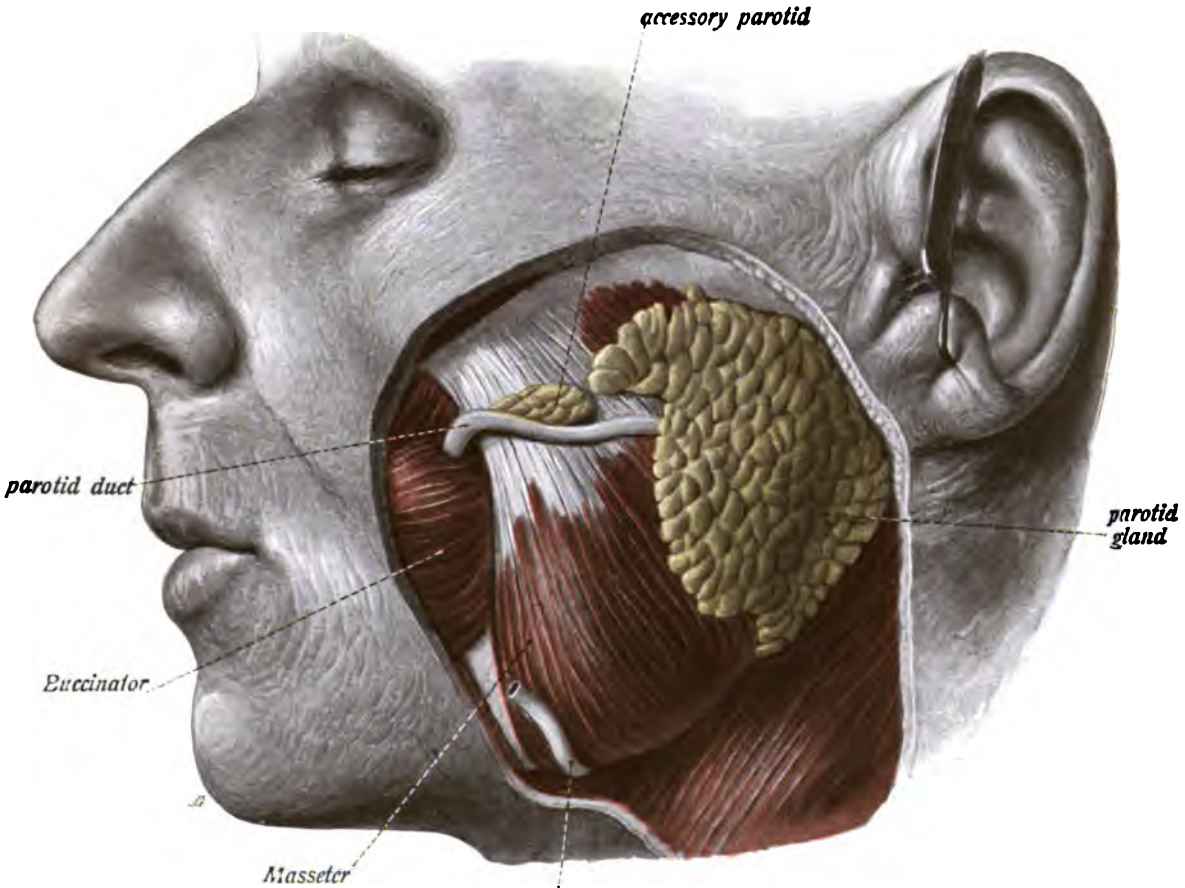

Fig. 358.

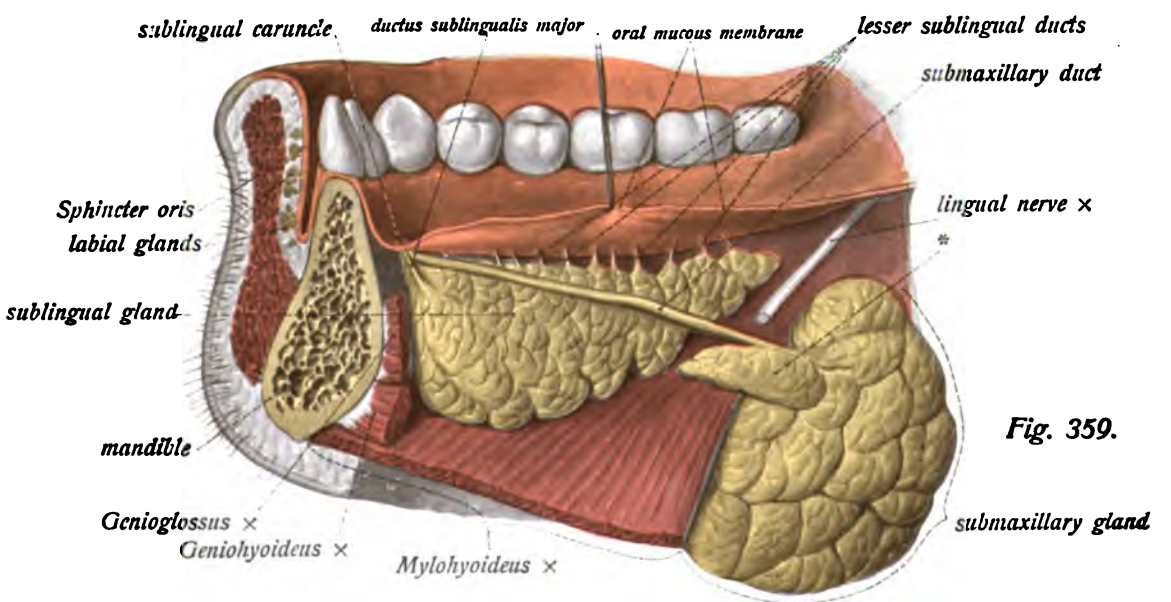

Fig. 359.

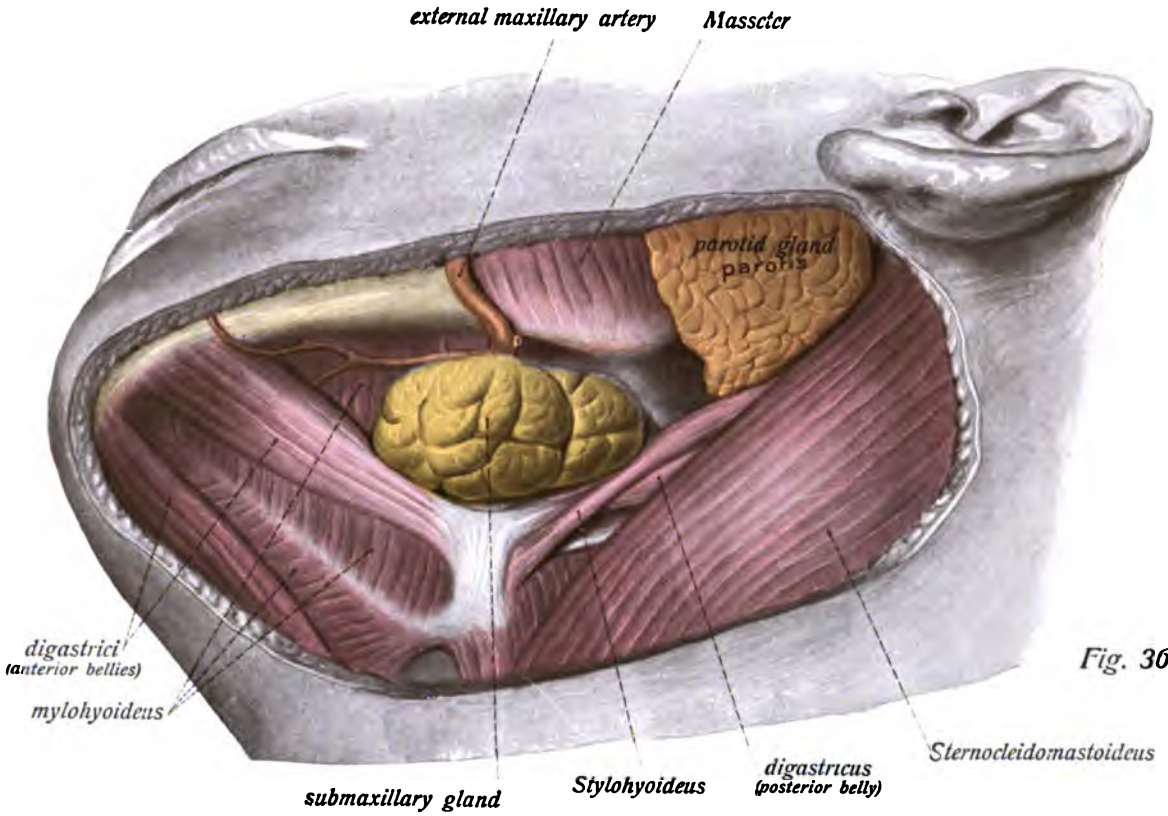

Fig. 360.

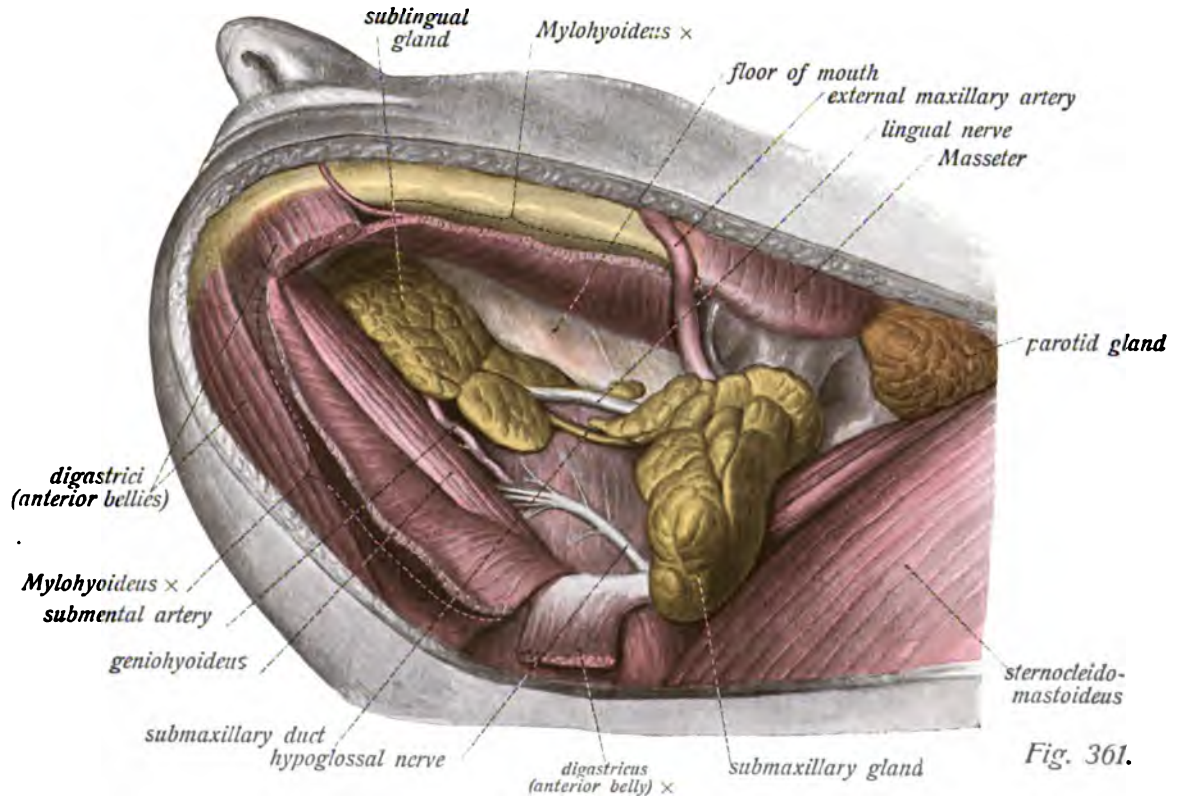

Fig. 361.

[The sublingual glands differ from the submaxillary and parotid in that each is really composed of a number of independent glands which open into the oral cavity, each by its own duct. These glands are known as the *alveolo-lingual glands* and their existence explains the multiplicity of ducts which characterizes the sublingual.—ED.]

The greater number of the smaller glands of the oral cavity have been previously considered (see pages 22 and 24). They are found generally distributed throughout the walls of the oral cavity and are usually smaller than a pea and of irregular shape. In some situations they are isolated, while in others they are compactly arranged. The following groups may be recognized:

1. The *labial glands* (Fig. 325), in the submucosa of the lips, situated between the mucous membrane and the musculature;

2. The *buccal glands* (Fig. 367), situated between the oral mucous membrane and the buccinator, between the fasciculi of the latter muscle, and even upon its outer surface;

3. The *molar glands* (Fig. 327), small isolated structures in the mucous membrane behind the last molar teeth;

4. The *lingual glands*, of small size, situated beneath the mucous membrane of the dorsum and partly surrounded by muscular tissue. According to their structure they are partly mucous and partly albuminous glands, and they are almost entirely absent from the tip of the organ, more numerous at the lateral margins, and particularly plentiful in the region of the circumvallate papillæ (albuminous glands) and among the lingual follicles. A somewhat larger gland among the smaller ones is the *anterior lingual gland* (gland of Blandin or Nuhn) (Fig. 357), situated in the tip of the tongue, which in reality is a conglomerate of several smaller glands. It is placed between the muscular fibers in the tip of the tongue and empties by several ducts upon or near the plica fimbriata;

5. The *palatine glands* (Fig. 327) are found in the mucous membrane of both the hard and the soft palates and particularly in the uvula, where they frequently lie between the muscle fibers. These glands are present upon both surfaces of the soft palate, but the anterior ones are much larger and more compactly grouped. They extend along the palatine arches to the tonsillar sinus, where they are exceedingly plentiful.

The lips are supplied with blood by the superior and inferior labial arteries; the accompanying veins empty into the facial. The lymphatics of this region drain into the submental lymphatic glands. The upper lip is supplied with sensation chiefly by the infraorbital nerve (second division of the trigeminus), the lower lip by the mental nerve (third division of the trigeminus); the labial muscles, like all those of the face, are supplied by the facial nerve.

The arteries for the cheeks are the branches of the external maxillary (facial), the transverse facial, and the infraorbital and buccal branches of the internal maxillary. The veins empty into the anterior facial vein, and the lymphatics pass to the submaxillary and parotid lymphatic glands. The skin is supplied with sensation by the infraorbital nerve, the mucous membrane by the buccal nerve. The motor nerve is the facial.

The arteries for the teeth in the upper jaw come from the internal maxillary (the superior anterior and posterior alveolar branches of the infraorbital artery); the nerves from the second division of the trigeminus, the anterior superior alveolar branches passing to the incisors, the middle superior alveolar branches to the canines and premolars, and the posterior superior alveolar to the molars. The teeth in the lower jaw are supplied by the inferior alveolar (inferior dental) artery and nerve.

The hard palate receives its blood-supply from the great palatine branch of the descending palatine and its nerves from the anterior palatine. The soft palate is supplied by the lesser palatine arteries and the middle and posterior palatine nerves. The lymphatic vessels of the palate empty into the deep facial lymphatic glands.

The tongue has two proper arteries, the linguals from the external carotids. Their chief and terminal branches, the deep lingual arteries (ranine), pass forward to the tip of the organ to anastomose with each other in the ranine arch. The

accompanying veins which transmit the greater quantity of the return blood empty into the common facial vein. The tongue is supplied by three pairs of nerves; the hypoglossal nerves innervate the muscles, the lingual nerves from the third division of the trigeminus supply sensation (the contained fibers of the chorda tympani also regulating secretion); the glossopharyngeal nerves are distributed only to the circumvallate papillæ and their immediate vicinity and are the special nerves of taste. The lymphatics of the tongue pass to the small lingual lymphatic glands situated in the floor of the mouth.

The arteries supplying the parotid gland are the superficial temporal and the transverse facial; the veins empty into the venæ comites of the above-mentioned arteries or into the external jugular. The lymphatics drain into the parotid lymphatic glands. The secretory stimuli are furnished by branches of the auriculotemporal nerve.

The submaxillary gland receives its blood-supply from the external maxillary (facial) artery and the return blood is poured into the anterior facial vein. The lymphatics pass to the submaxillary lymphatic glands and the secretory nerve is the chorda tympani (running in the lingual nerve).

The sublingual gland is supplied with blood by the branches of the sublingual artery and its veins empty into those of the tongue. The lymphatics run to the submaxillary lymphatic glands, and nerve fibers are furnished by the lingual (chorda tympani).

THE FOREGUT.

The foregut includes the pharynx, the œsophagus, and the stomach.

THE PHARYNX.

The *pharynx* (Figs. 362 to 367) may be regarded as a cylindrical tube, markedly flattened from before backward, and is situated in the vertical axis of the body. The lateral and posterior walls are composed of muscular tissue, but anteriorly it communicates by a large opening with the nasal and oral cavities. Its roof is formed by the base of the skull. Its posterior wall is in relation with the anterior surfaces of the cervical vertebræ and extends downward to the intervertebral disc between the bodies of the sixth and seventh cervical vertebræ, where it passes into the œsophagus; it is separated from the anterior longitudinal ligament and the longi capitis et colli by loose areolar tissue and by the deep (prevertebral) layer of the cervical fascia. Its lateral wall is in relation with the common and internal carotid arteries, the internal jugular vein, and the glossopharyngeal, pneumogastric, spinal accessory, hypoglossal, and sympathetic nerves.

The pharyngeal cavity (Figs. 328, 364, and 365) is flattened from before backward and is composed of three parts which are placed one above the other but are not sharply separated; they are the *nasal portion* (nasopharynx), the *oral portion* (oropharynx), and the *laryngeal portion* (laryngopharynx). The nasal portion (Figs. 362 to 365) communicates with the nasal cavity through the choanæ (see page 87) and is separated from the oral cavity by the soft palate. Its highest portion is known as the *pharyngeal fornix* (Fig. 363) and is situated immediately beneath the base of the skull.

Each lateral wall of this portion presents the pharyngeal orifice of the tuba auditiva (Eustachian tube), which is on a level with the inferior meatus of the nose. It is a slit-like opening, directed obliquely from above downward and from before backward, the anterior and posterior boundaries being respectively designated as the anterior and posterior lip. The posterior lip is the thicker and contains the free extremity of the cartilaginous tube, which causes a projection known as the *torus tubarius* (Fig. 365) (see section on Organs of Special Sense), while the anterior lip is continuous with a fold which gradually disappears upon the posterior surface of the soft palate, the *salpingopalatine fold* (Fig. 362). At the lower margin of the opening of

FIG. 362.—View of the nasal portion of the pharynx seen from behind, the posterior pharyngeal wall being divided in the middle line.

FIG. 363.—View of the nasal portion of the pharynx and the left palatine tonsil, glossopalatine and pharyngopalatine arches.

The skull is divided close to the median line, the uvula cut off at its root and the tongue drawn somewhat forward.

FIG. 364.—View of the pharynx from behind, its posterior wall being divided in the median line. Horizontal incisions have also been made in its upper portion and its posterior and lateral walls reflected.

FIG. 365.—The muscles of the palate and pharynx seen from behind.

The pharynx has been opened along the posterior median line and its walls turned back. The constrictors have been exposed from the inner surface. On the left side the levator veli palatini has been removed.

FIG. 366.—The constrictors of the pharynx seen from behind.

The posterior part of the skull has been removed. * = A bundle of the superior constrictor arising from the base of the skull.

FIG. 367.—The constrictors of the pharynx seen from the side.

The ramus of the mandible and the lateral portions of the skull have been removed; also the stylopharyngeus, the anterior belly of the digastric and the styloglossus. * = A bundle of the superior constrictor arising from the base of the skull.

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the tube there is an inconstant elevation caused by the underlying levator veli palatini, and a rather distinct fold, the *salpingopharyngeal fold* (Figs. 363 and 364), extends from the torus tubarius to the lateral pharyngeal wall, where it gradually disappears, and above and behind the torus tubarius the pharyngeal fornix upon either side forms a narrow blind pocket, the *pharyngeal recess* (cavity of Rosenmüller). Between the two tubal orifices and actually in the roof of the pharynx is situated the *pharyngeal tonsil* (Fig. 363), a lymphatic structure which is usually distinct only in children.*

The oral portion of the pharynx communicates with the oral cavity through the isthmus of the fauces, the boundary being marked by the pharyngopalatine arches (see page 24). It is the narrowest portion of the pharynx and presents no special structures, except a fold of mucous membrane, the *pharyngo-epiglottic fold*, which passes from the lateral margin of the epiglottis to the outer pharyngeal wall and separates the oropharynx from the laryngopharynx.

The laryngeal portion of the pharynx (Figs. 364 and 365) is the only portion which has an extensive anterior wall. It lies behind the larynx, the posterior wall of which is distinctly visible through the thin pharyngeal mucous membrane, so that there may be recognized a median elevation produced by the plate of the cricoid cartilage (and the arytenoid cartilages) and two deep lateral depressions which correspond to those between the cricoid and arytenoid cartilages internally, and the posterior surface of the thyreoid cartilage externally. These lateral depressions are termed the *piriform recesses* and present a fold of mucous membrane, the fold for the laryngeal nerve (Fig. 364), which passes obliquely from above downward and from without inward, and contains the superior laryngeal nerve. In the laryngopharynx is also situated the entrance to the larynx or *aditus laryngis* (see page 97).

The pharyngeal wall consists of a mucous membrane, of a submucous layer, and of a mus-

* The typical pharyngeal tonsil of the child consists of a number of ridges separated by sulci which converge toward a depression, the *bursa pharyngea* (Fig. 363). This depression subsequently disappears.

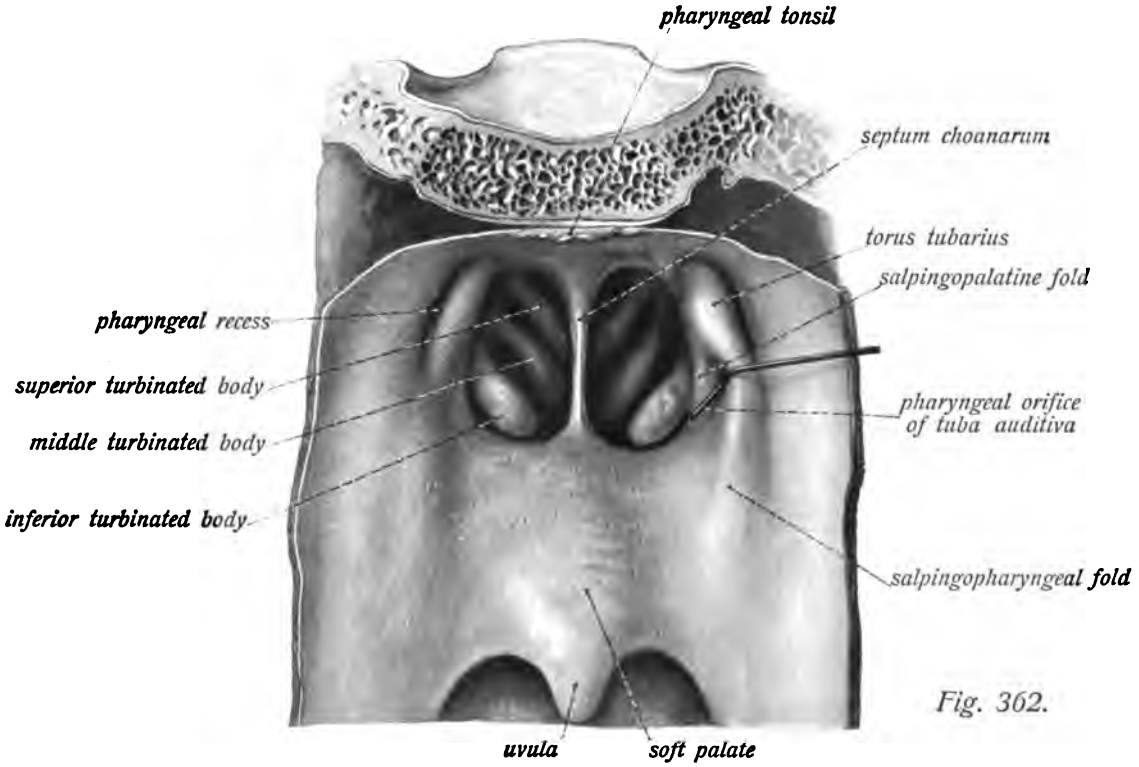

Fig. 362.

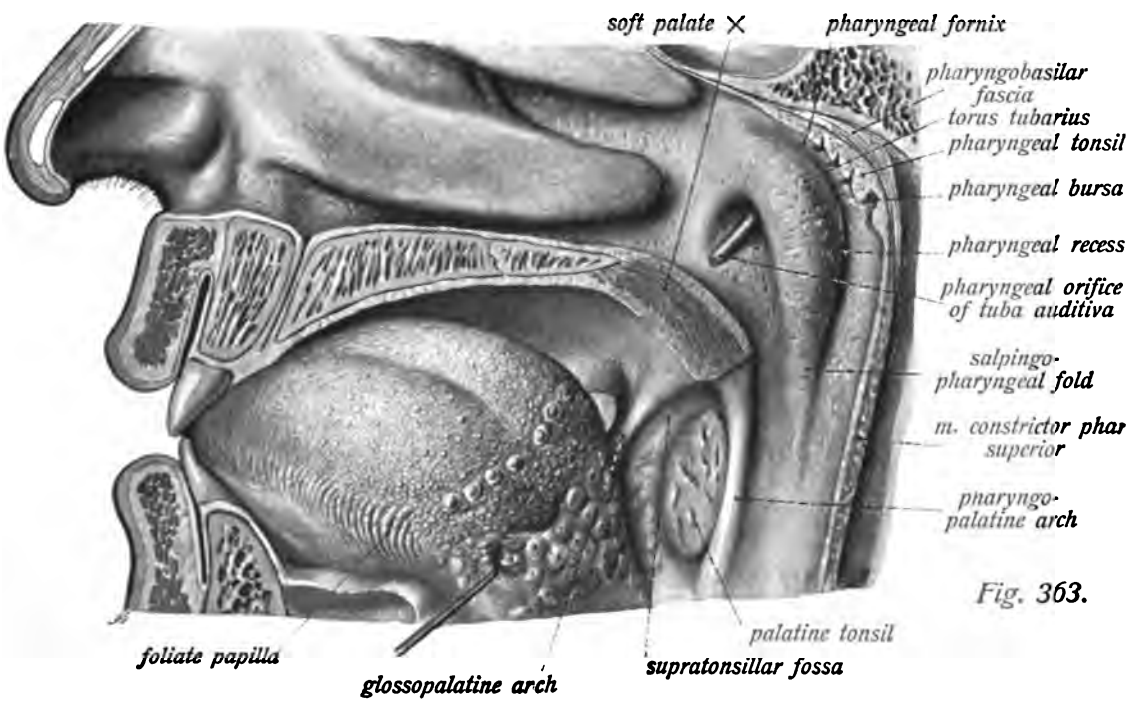

Fig. 363.

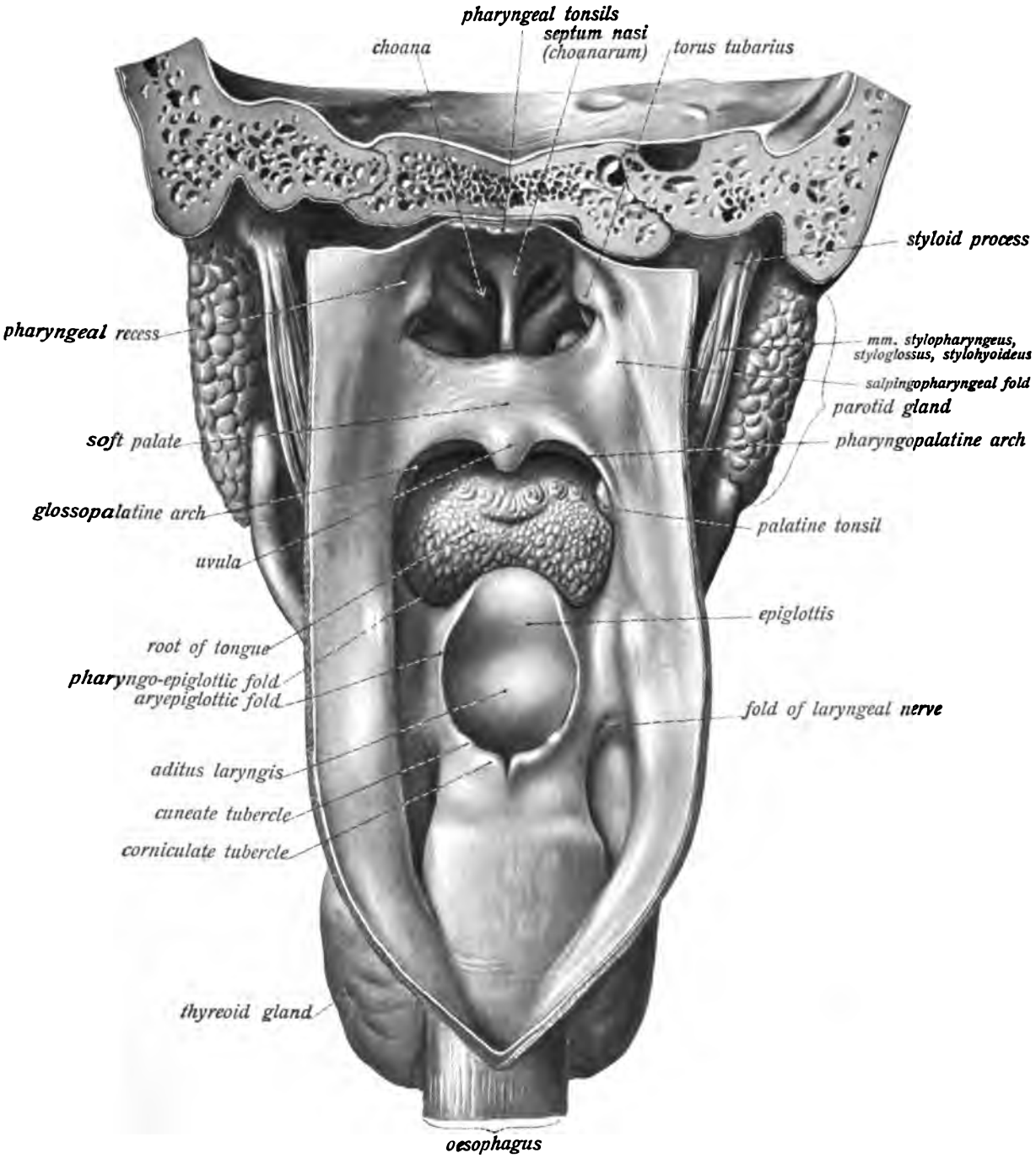
pharyngeal tonsils
septum nasi
(choanarum)
choana
torus tubarius
styloid process
pharyngeal recess
mm. stylopharyngeus,
styloglossus, stylohyoideus
salpingopharyngeal fold
parotid gland
soft palate
pharyngopalatine arch
glossopalatine arch
palatine tonsil
uvula
epiglottis
root of tongue
pharyngo-epiglottic fold
arycpiglottic fold
fold of laryngeal nerve
aditus laryngis
cuneate tubercle
corniculate tubercle
thyreoid gland
oesophagus

Fig. 364.

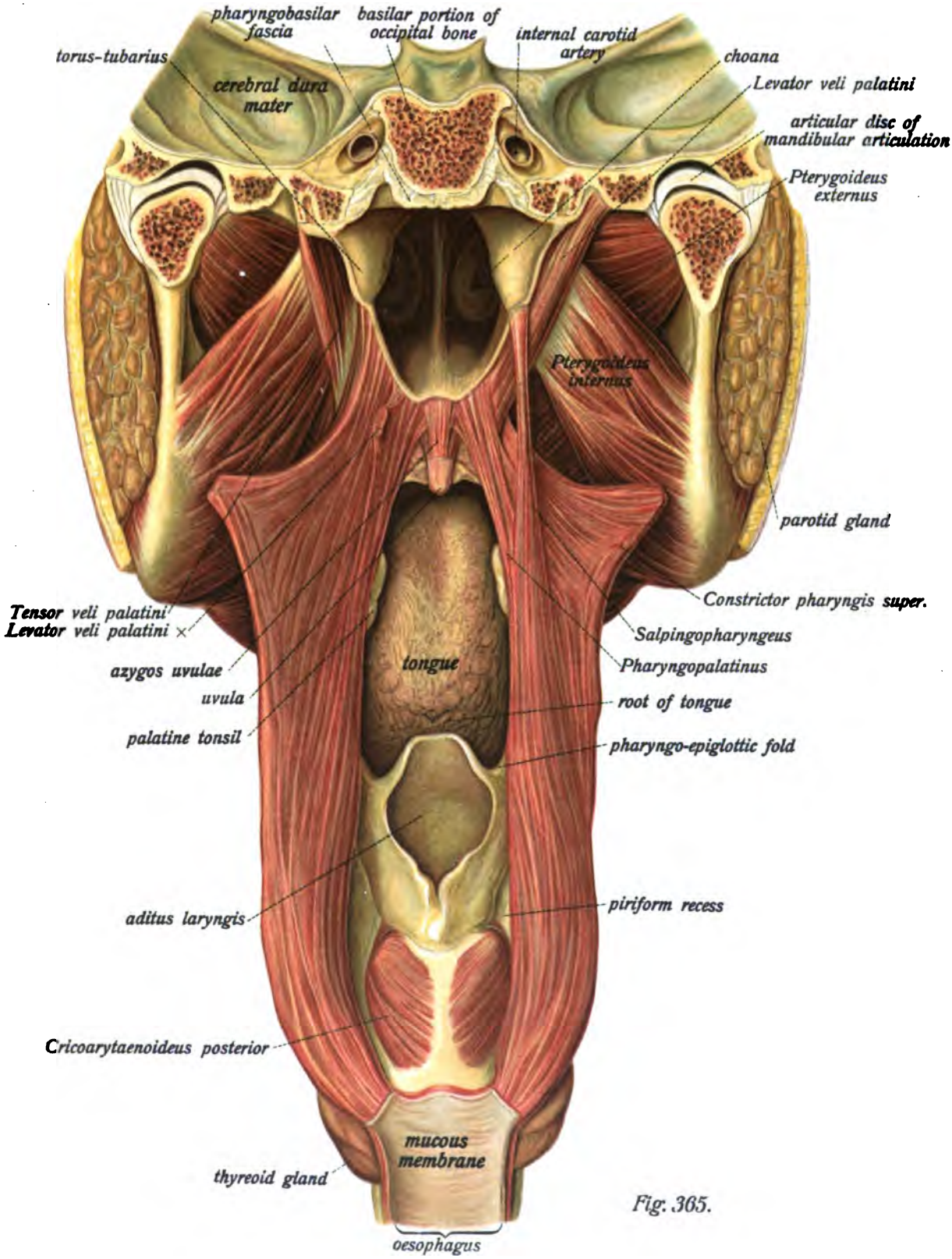
pharyngobasilar fascia
basilar portion of occipital bone
internal carotid artery
torus-tubarius
choana
cerebral dura mater
Levator veli palatini
articular disc of mandibular articulation
Pterygoideus externus
Pterygoideus internus
parotid gland
Tensor veli palatini
Levator veli palatini
Constrictor pharyngis super.
Salpingopharyngeus
azygos uvulae
tongue
Pharyngopalatinus
uvula
root of tongue
palatine tonsil
pharyngo-epiglottic fold
aditus laryngis
piriform recess
Cricoarytaenoideus posterior
mucous membrane
thyreoid gland
oesophagus

Fig. 365.

duct and are known as the *accessory parotid gland.* The parotid gland is grayish-yellow or yellowish-brown in color and seems distinctly lobulated like the other salivary glands, but the lobules are quite small; at the margins of the gland they are frequently isolated, but throughout the chief mass of the structure they are arranged compactly.

The *submaxillary gland* (Figs. 359 and 360) is a rounded structure, the long axis of which is in the sagittal plane. It is found in the neck, in the submaxillary region, immediately beneath the platysma and the cervical fascia, the latter structure forming a fibrous capsule for the gland.

The greater portion of the submaxillary gland lies beneath the mylohyoid muscle in the space between the angle of the jaw and the two bellies of the digastric (Fig. 360). It also borders upon the stylohyoid and styloglossus, and its internal surface is in relation with the hyoglossus. The external maxillary (facial) artery and its accompanying vein run in the immediate vicinity. The upper margin of the gland rests against the body of the jaw and is lodged in a depression which is not always distinct, the submaxillary depression (see Vol. I, p. 72).

The gland is yellowish-white in color and is distinctly lobulated, the lobules being considerably larger than those of the parotid. A thin and markedly flattened glandular process extends upward between the internal pterygoid and the mylohyoid to the sublingual gland and accompanies the secretory duct for some distance (Fig. 359, *).

The *submaxillary duct* (*ductus Whartoni*) (Fig. 359) is the size of an ordinary quill; it is given off from the upper part of the gland and runs above the mylohyoid, between that muscle and the mucous membrane of the floor of the mouth (or the sublingual gland), passing from behind forward and inward and producing the sublingual fold (see page 36). The orifice in the oral cavity is situated on the sublingual caruncle beside the frenulum beneath the tip of the tongue (Fig. 350).

The *sublingual gland* (Figs. 359 and 361) is an elongated flattened structure with its long axis in the sagittal plane, and may be distinctly seen beneath the mucous membrane of the floor of the mouth when the tip of the tongue is raised. The external border is lodged in a depression in the inferior maxillary bone, the sublingual depression (see Vol. I, p. 72), and the posterior margin is in relation with the submaxillary gland, the internal margin with the genioglossus, and its lower surface rests upon the mylohyoid. In the immediate vicinity of the gland are the sublingual artery and the lingual nerve.

The gland is white or light-gray in color and has distinct lobules which are smaller than those of the submaxillary. It is the smallest of the three salivary glands and is not so compactly arranged, frequently consisting of several glandular masses which are only loosely connected. It does not possess a common duct, but the secretion from the distinctly separated glandular components is poured out through ten or twelve ducts known as the *lesser sublingual ducts* (*ducts of Rivinus*), which empty immediately into the oral cavity by a number of small punctiform orifices in the region of the sublingual fold (Figs. 350 and 359). The anterior portion of the gland, however, frequently gives off a somewhat larger duct, which is known as the *greater sublingual duct* (*duct of Bartholin*), and this either empties independently at the sublingual caruncle beside the submaxillary duct or pours its secretion into the latter structure immediately before its termination. Both the submaxillary and the sublingual glands consequently empty into the oral cavity, while the orifice of the duct of the parotid gland is situated in the vestibulum oris.